



ITS MASTER PLAN UPDATE



JULY 2020

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EXECUTIVE SUMMARY

VISION

FOR THE ITS MASTER PLAN UPDATE

To provide a safe, efficient, and reliable customer centered transportation network through the use of technology, timely maintenance, and public communication.




ITS
MASTER PLAN UPDATE

GOALS & OBJECTIVES



The continued maturity of the City's ITS program, and the ongoing evolution of technologies require the City to refocus and develop refined ITS goals and objectives to enhance the longevity and sustainability of the system. Project, policy, and organizational improvements included in this ITS Master Plan will provide the means by which to achieve the above vision.

This ITS Master Plan will play a pivotal role in allowing the City to more effectively maintain system infrastructure, to position for the adaptation of new technologies, to enhance the reliability of the communication network, and to enhance TOC operations.

The goals and objectives for the Update include:

- ✓ Establish a Maintenance and Replacement Strategy for Existing Equipment
- ✓ Document Opportunities for Considering Deployment of New and Emerging Technologies
- ✓ Advance the City's Plan for Creating a Redundant Communications Network
- ✓ Establish a Strategy for Future Deployment of Additional Equipment
- ✓ Establish Goals and Expectations for TOC Staffing
- ✓ Establish a plan for coordination with neighboring and regional jurisdictions' systems, policies, and protocols



ENVISIONING OF ITS TECHNOLOGIES

Traffic operations and management technology is constantly advancing and evolving, which makes it an important consideration during the formulation of implementation strategies. It is crucial that the implementation process takes full advantage of the existing ITS technologies available while also formulating strategies that align with where technological advancements are heading. As such, various ITS technologies have been identified for consideration in this Master Plan Update. These technologies have been prioritized based on the City's goals and needs, as well as cost and feasibility, and have been categorized into Near-Term (0-5 year horizon), Mid-Term (5-10 year horizon), and Long-Term technology solutions for future consideration.



Figure ES-1 – Traffic Signals and Existing Communications Network

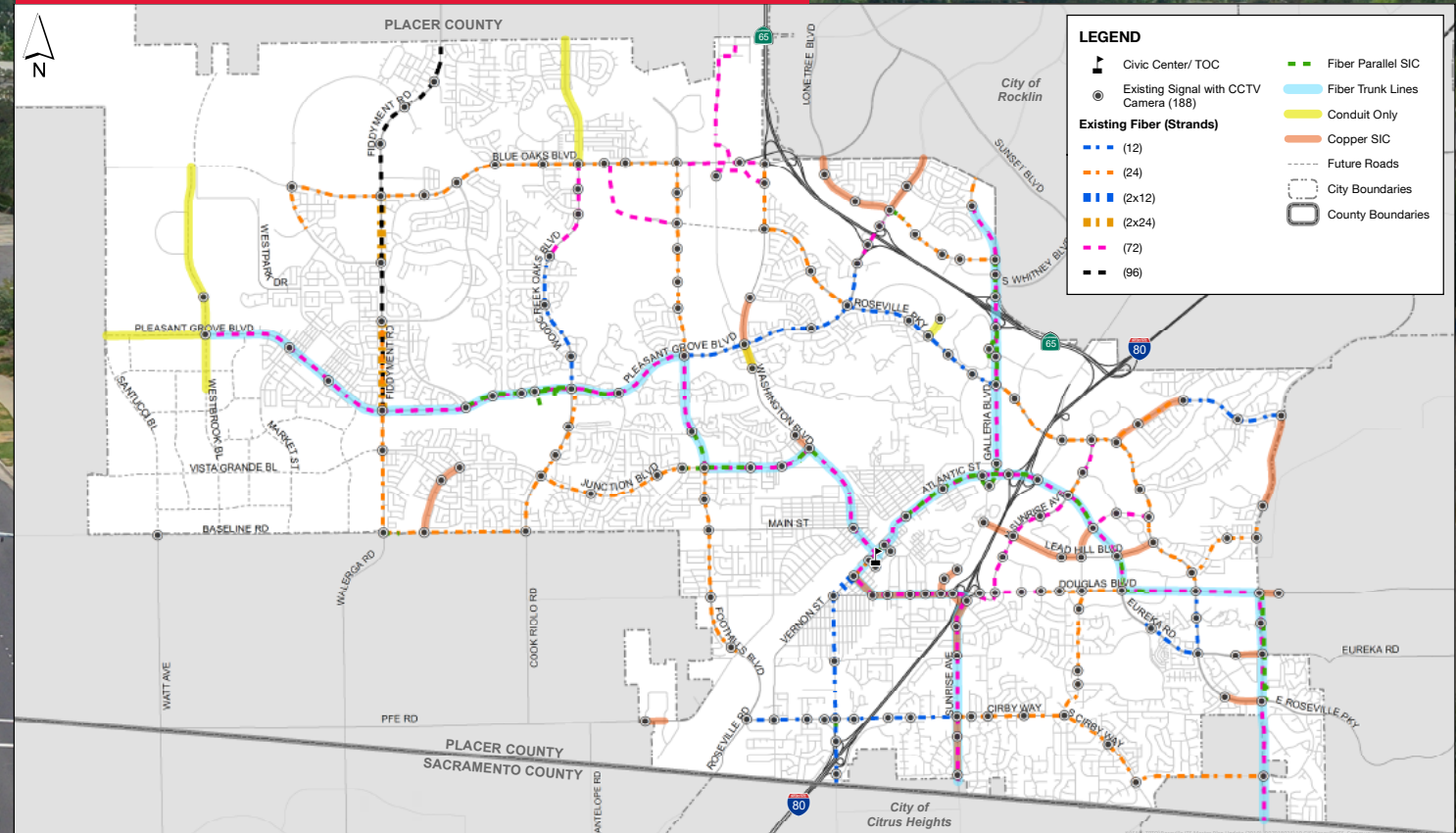


Figure ES-2 – ITS Technology Solutions Matrix

Near-Term (0-5 Year Horizon)	Mid-Term (5-10 Year Horizon)	Technology Solutions for Future Consideration
N1. Big Data	M1. Automated Functions	L1. Multi-Systems Operator
N2. Connected and Autonomous Vehicle (CAV) Technology	M2. CCTV Camera Audio Capabilities	L2. Increased Use of Social Media
N3. Network Failover and Redundancy	M3. Bus Rapid Transit and Transit Signal Priority	L3. CCTV Camera View Shed and Resolution
N4. Automated Traffic Signal Performance Measures (ATSPM)	M4. Automated Pedestrian Detection	L5. Deployment of Citywide Wi-Fi Network
N5. Transportation Network Carriers (TNCs)	M5. Field Hubs for Specific Plan Areas	L6. Pollution Monitoring
N6. Mobile Applications		L8. Congestion Pricing
N7. Crash Detection Systems		L9. Regional System Redundancy
		L10. Trailblazers

PLAN IMPLEMENTATION



Individual implementation projects were developed based on identification of strategic corridors and technologies. The projects have been identified by focusing on enhancing the City's existing ITS infrastructure while considering priorities and goals. These projects include the following elements:

- ✓ Communications Upgrade
- ✓ Wifi Travel Time Corridors
- ✓ Changeable Message Sign Deployments
- ✓ Traffic Signal Upgrades (including video detection)
- ✓ CCTV Camera Deployments

Figure ES-4 - Ultimate Signal, CCTV, and CMS Deployment

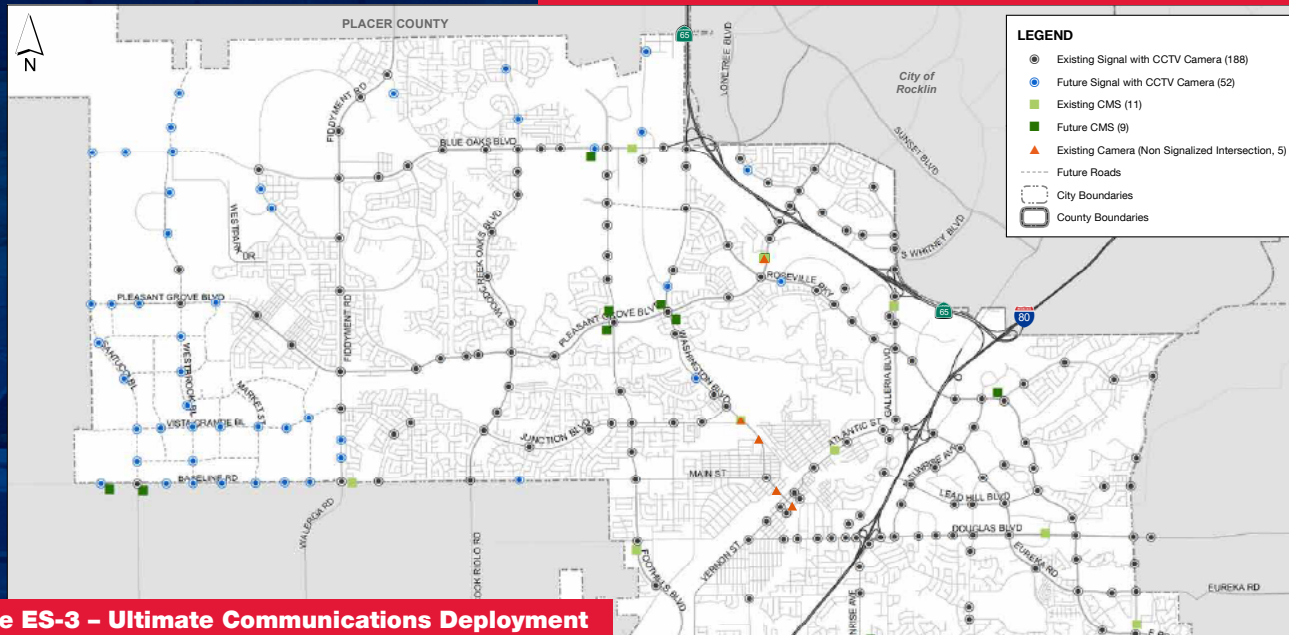
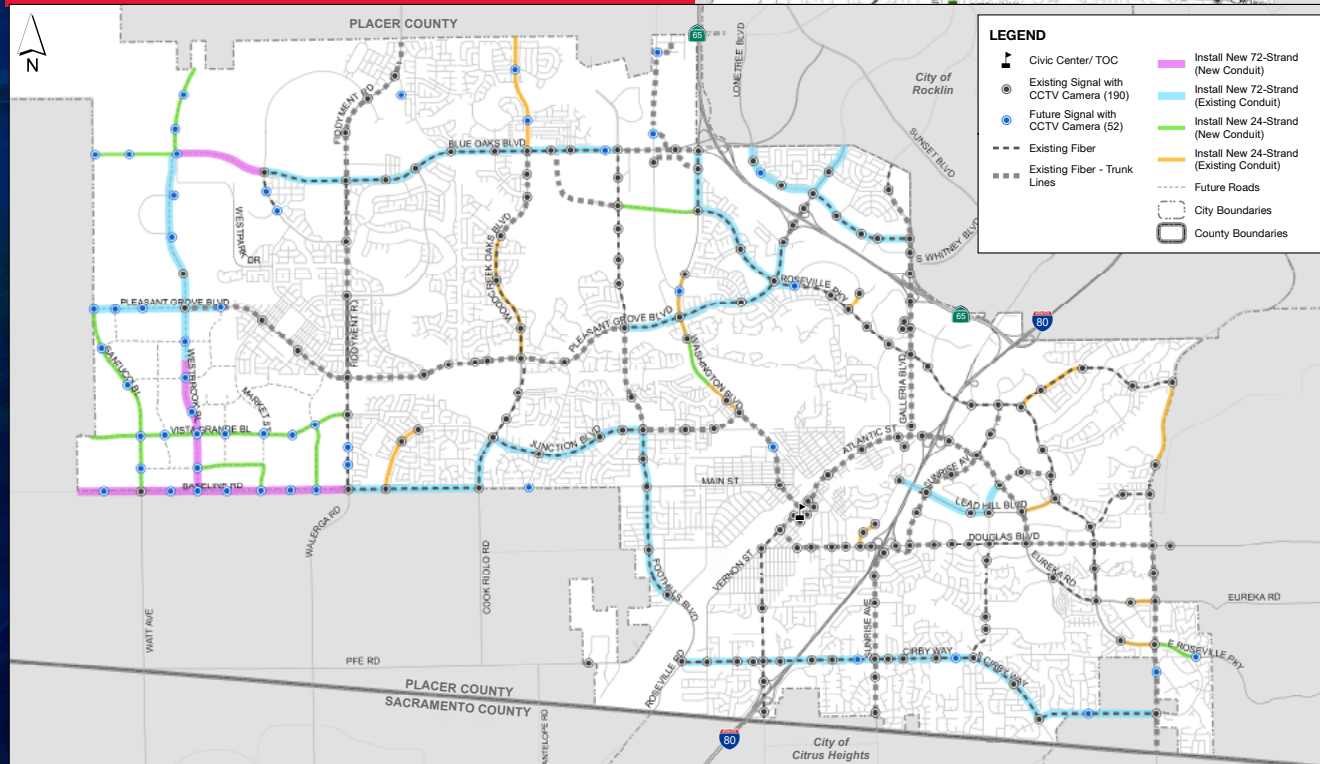


Figure ES-3 - Ultimate Communications Deployment



OPERATIONS AND MAINTENANCE



Operations and Maintenance procedures are essential to define the appropriate staffing levels, training, operational processes, and maintenance plans necessary to sustain an effective ITS.

- ✓ Maintenance activities fall into two categories: preventive and corrective.
- ✓ Scheduling preventive maintenance measures and timing should be based on manufacturers' recommendations.
- ✓ To address corrective maintenance, the City must develop contingency plans to address the inevitable unknown device failures.
- ✓ In addition to maintenance activities, there are also replacement costs due to upgrading legacy equipment or end of lifespan that the City should consider.

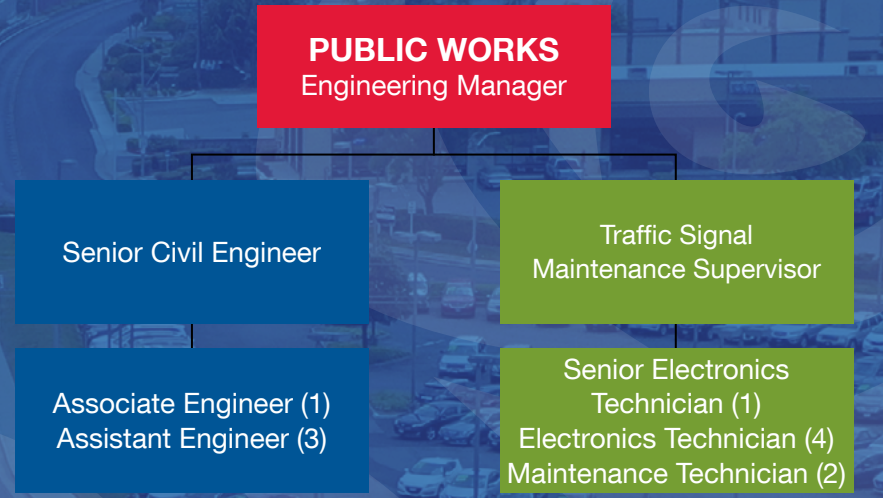


Figure ES-5 - Traffic Operations Section Organization Chart

FUNDING OPPORTUNITIES



The City of Roseville has been successful at identifying and obtaining numerous grants to assist with the deployment of their existing ITS. Many of these same local, state, and federal funding opportunities are still available including:

- ⚙ Highway Safety Improvement Program (HSIP)
- ⚙ Senate Bill 1 (SB-1)
- ⚙ Surface Transportation Block Grant Program (STBG)
- ⚙ Transportation Infrastructure Finance and Innovation Act (TIFIA)
- ⚙ Better Utilizing Investments to Leverage Development (BUILD) Grants
- ⚙ The Nationally Significant Freight and Highway Projects (INFRA) Program
- ⚙ Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD)
- ⚙ Clean Air grants

I INTRODUCTION

The City of Roseville adopted its first Intelligent Transportation System (ITS) Master Plan in 2005. This master plan document described the existing inventory of traffic signal and ITS elements, future goals, and a migration path for technology to become more prominent and integrated with the agency's forward thinking traffic management program. Subsequently, the City's ITS Master Plan was updated in 2012 to account for the implementation of ITS elements, major advances in transportation technology and systems, particularly in the areas of camera technology, detection, and performance monitoring techniques. The ITS Master Plan is now being updated to reflect more recent changes to the City's transportation system, and re-calibrate the City's path towards achieving its goals and objectives with an eye toward the next 10 years of technology deployment and infrastructure buildout.

Transportation management is rapidly growing in terms of technology, software, and applications. The future of transportation includes connected and autonomous vehicle (CAV) technology, electrification, automated traffic signal performance measures (ATSMPs), big data, adaptive traffic control systems (ATCS), and a committed focus on more effective operations and management of systems rather than just capital improvements.

There is no way to build the way out of congestion, and the only way to effectively improve mobility is more enhanced management of the transportation network. Continuing to build lanes and add capacity will become more and more restrictive, and ITS programs will continue to mature in their capability to actively manage traffic (both reactive and proactive management), incidents, events, and construction work zones.

It is acknowledged that there is an expectation from travelers that a City's transportation system is equipped with the tools to move people as efficiently and safety as possible, yet the public rarely understands what is involved in implementing these tools. This ITS Master Plan Update provides the City of Roseville with the opportunity to enhance their existing ITS program with a solid foundation of strategic and necessary infrastructure improvements, in combination with collaborative growth across the region, in operations and traffic management capabilities.

This Plan is intended to provide a strategic direction for the City to plan for capital and operational investments. External stakeholders will see benefit in this Plan as providing a direction of where development, design standardization, and anticipated technologies and piloting innovation will be part of the City's investments.





A. Background

The City of Roseville continues to lead the way in the Sacramento Region with its comprehensive traffic management system. The City's visionary efforts to invest in traffic signal infrastructure began in the 1980s when approximately 60 traffic signals were in place and the City had a moderate population level of nearly 45,000. Today, largely driven by a growing population reaching 135,000, the City operates and maintains 190 traffic signals and 192 closed circuit television (CCTV) camera systems with the backbone of an extensive communications network connected to the City's Traffic Operations Center (TOC).

An important intermediate milestone in this progression was the formation of a Citizen Task Force in 2002. It was the priority that this group placed on synchronized traffic control that guided City staff to initiate their first Intelligent Transportation System (ITS) Master Plan in 2003 with approval and adoption in 2005.

The City has largely followed the implementation guidelines and strategies established by the initial 2005 Plan and subsequent 2012 ITS Master Plan. Aided by a tremendous growth spurt in the mid-2000s, development activity and an aggressive grant program provided the means by which to realize numerous corridor-based deployments as opposed to the more typical piece-meal implementation commonly experienced in more established cities of a similar size. The City's existing ITS network is robust, thorough, and is situated well for future growth to the western extents of the City and to adjacent jurisdictions. Implementation to date includes a communications network (fiber optic and legacy copper interconnect), CCTV cameras, video detection systems, emergency vehicle priority (EVP), changeable message signs (CMS), wifi readers, a traveler information system, signal coordination, and the construction and operation of a centralized TOC.


B. Stakeholder Participation

A series of stakeholder workshops were conducted in January 2012 as part of the development and update of the 2012 ITS Master Plan. These workshops were intended to provide attendees a background of the City's ITS program, to outline ITS goals and objectives, to provide an assessment of existing conditions and new technologies, and to outline the overall Plan update process. Input and feedback received during these workshops were documented in the 2012 ITS Master Plan, and was used to refine the Plan as part of this ITS Master Plan Update.

II VISION, GOALS, AND OBJECTIVES

A. Vision

The City of Roseville’s Intelligent Transportation System (ITS) vision was developed by the City as a means to clearly define a focus and direction for the ITS program. According to the City’s 2012 ITS Master Plan, the following over-arching operational needs/mission statement was developed and, per the City’s request, is translated into the vision for this Master Plan Update:



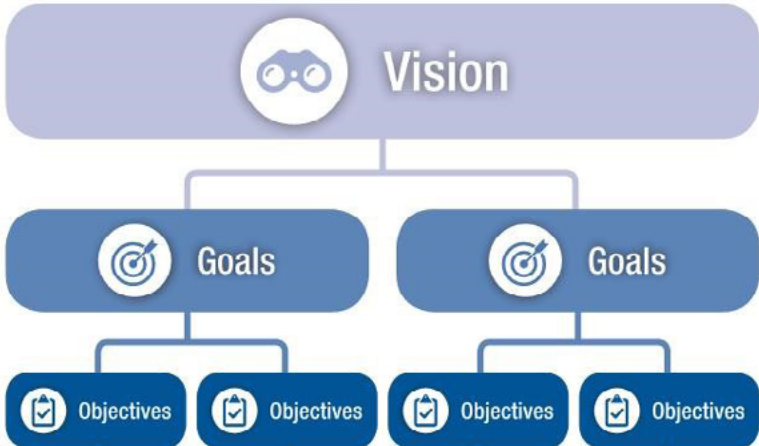
To provide a safe, efficient, and reliable customer centered transportation network through the use of technology, timely maintenance, and public communication.

B. Goals and Objectives

The continued maturity of the City’s ITS program, and the ongoing evolution of technologies require the City to refocus and develop refined ITS goals and objectives to enhance the longevity and sustainability of the system. Project, policy, and organizational improvements included in this ITS Master Plan will provide the means by which to achieve the above vision. This ITS Master Plan will play a pivotal role in allowing the City to more effectively maintain system infrastructure, to position for the adaptation of new technologies, to enhance the reliability of the communication network, and to enhance TOC operations.

Goals and objectives expand the City’s vision statement and address the environment, shortcomings, and needs to achieve the vision. Together, the goals and objectives serve as the framework for strategies and tactics to plan and implement ITS projects. Goals are broader than objectives, and they break the vision into more manageable and tangible segments. Objectives must be detailed and specific so they may provide a means of measuring whether the implemented ITS network meets the City’s goals and needs. **Figure 1** provides the hierarchy of the project vision, goals, and objectives.

Figure 1 – Vision, Goals, and Objectives Flow



The proposed Goals and Objectives for this ITS Master Plan are presented in **Table 1**. These goals and objectives are derived from the vision stated above and form the framework for implementation strategies by establishing manageable and tangible statements. Specific ITS projects and solutions that address these goals and objectives are presented later in this document.

Table 1 – ITS Master Plan Update Goals and Objectives

Goal ID	Goal	Objectives
A	Establish a Maintenance and Replacement Strategy for Existing Equipment	<ul style="list-style-type: none"> Identify a strategy to replace existing legacy equipment Develop a strategy to utilize a routine maintenance schedule for existing equipment Include funding expenditure plan for equipment replacement and maintenance
B	Document Opportunities for Considering Deployment of New and Emerging Technologies	<ul style="list-style-type: none"> Identify technologies that may be appropriate to integrate into the system in the future Capture deployment strategy for future implementation Stay at the forefront of technology to provide system users with more traveler information and equip staff to be more responsive and efficient
C	Advance the City’s Plan for Creating a Redundant Communications Network	<ul style="list-style-type: none"> Identify the areas of redundancy needs Include implementation plan for filling redundant gaps Leverage efforts of other City departments to build out integrated communications network Include funding expenditure plan of communications network expansion for redundancy
D	Establish a Strategy for Future Deployment of Additional Equipment	<ul style="list-style-type: none"> Include deployment implementation plan of devices in new areas of the City Include sufficient communications network for additional expansion Include funding expenditure plan deployment of future equipment
E	Establish Goals and Expectations for TOC Staffing	<ul style="list-style-type: none"> Evaluate if TOC expansion is required Develop strategy if additional staffing is required to manage traffic operations, and identify funding mechanism to support these investments
F	Establish a plan for coordination with neighboring and regional jurisdictions' systems, policies, and protocols	<ul style="list-style-type: none"> Identify implementable strategies to improve coordination and communication with neighboring agencies (Sacramento County, Placer County, Rocklin, Citrus Heights) to enhance regional traffic management



III EXISTING ITS DEPLOYMENT

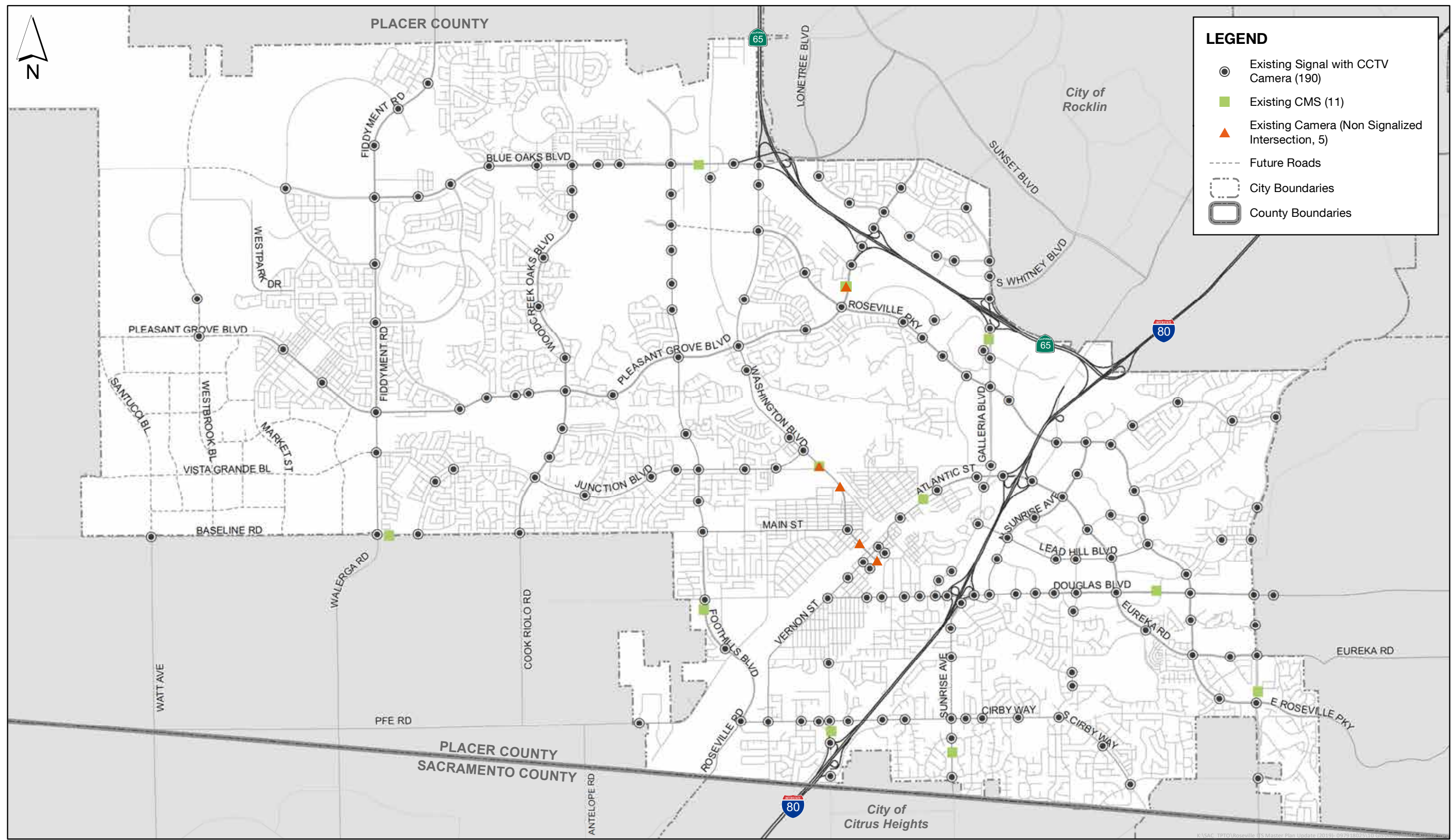
The following is a summary of the current inventory of the City’s ITS program:

A. Traffic Signals

The City of Roseville currently owns, operates, and maintains a total of 190 traffic signals, with the majority located on key arterials and collectors. The traffic signal controllers are Naztec 2070 controllers. The City uses Trafficware’s ATMS.now traffic signal central management system to manage all traffic signals connected to the City’s communications network.

Figure 2 presents the locations of the existing traffic signals.

Figure 2 – Existing Traffic Signals, CCTV Cameras, and CMS



The City is currently running weekday peak period time-of-day coordination along twenty (20) arterial roadways. These arterial roadways include:

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Douglas Boulevard – Judah Street to Harding Boulevard 2. Douglas Boulevard – Rocky Ridge Drive to Cavitt Stallman Road 3. Douglas Boulevard – Sunrise Avenue to Rocky Ridge Drive 4. Cirby Way – Foothills Boulevard to San Simeon Drive 5. Eureka Road – Wills Road to Douglas Boulevard 6. Rocky Ridge Drive – Douglas Boulevard to Professional Drive 7. Galleria Boulevard – Roseville Parkway to Highland Park Drive 8. Sunrise Avenue – Cirby Way to Sandringham Way 9. Roseville Parkway – Secret Ravine to Douglas Boulevard 10. Vernon Street – Lincoln Street to Douglas Boulevard | <ol style="list-style-type: none"> 11. Pleasant Grove Boulevard – Woodcreek Oaks to Highland Park Drive 12. Cirby Way – Sunrise Avenue to Rocky Ridge Drive 13. Harding Boulevard – Douglas Boulevard to Lead Hill Boulevard 14. Rocky Ridge Drive – Cirby Way to Maidu Drive 15. Sierra College Boulevard – Old Auburn Road 16. Foothills Boulevard – McAnally Drive to Vineyard Road 17. Fairway Drive – Central Park Drive to Five Star Drive 18. Washington Boulevard - Junction Boulevard to Sawtell Road 19. Roseville Parkway – Pleasant Grove to Secret Ravine Parkway 20. Blue Oaks Boulevard – Washington Boulevard to Diamond Creek Boulevard |
|--|--|

Vehicle detection at signalized intersections is primarily provided using in-pavement loops and video detection. However, the City currently has two (2) intersections which provide radar detection using the AccuScan 600C system manufactured by Econolite.

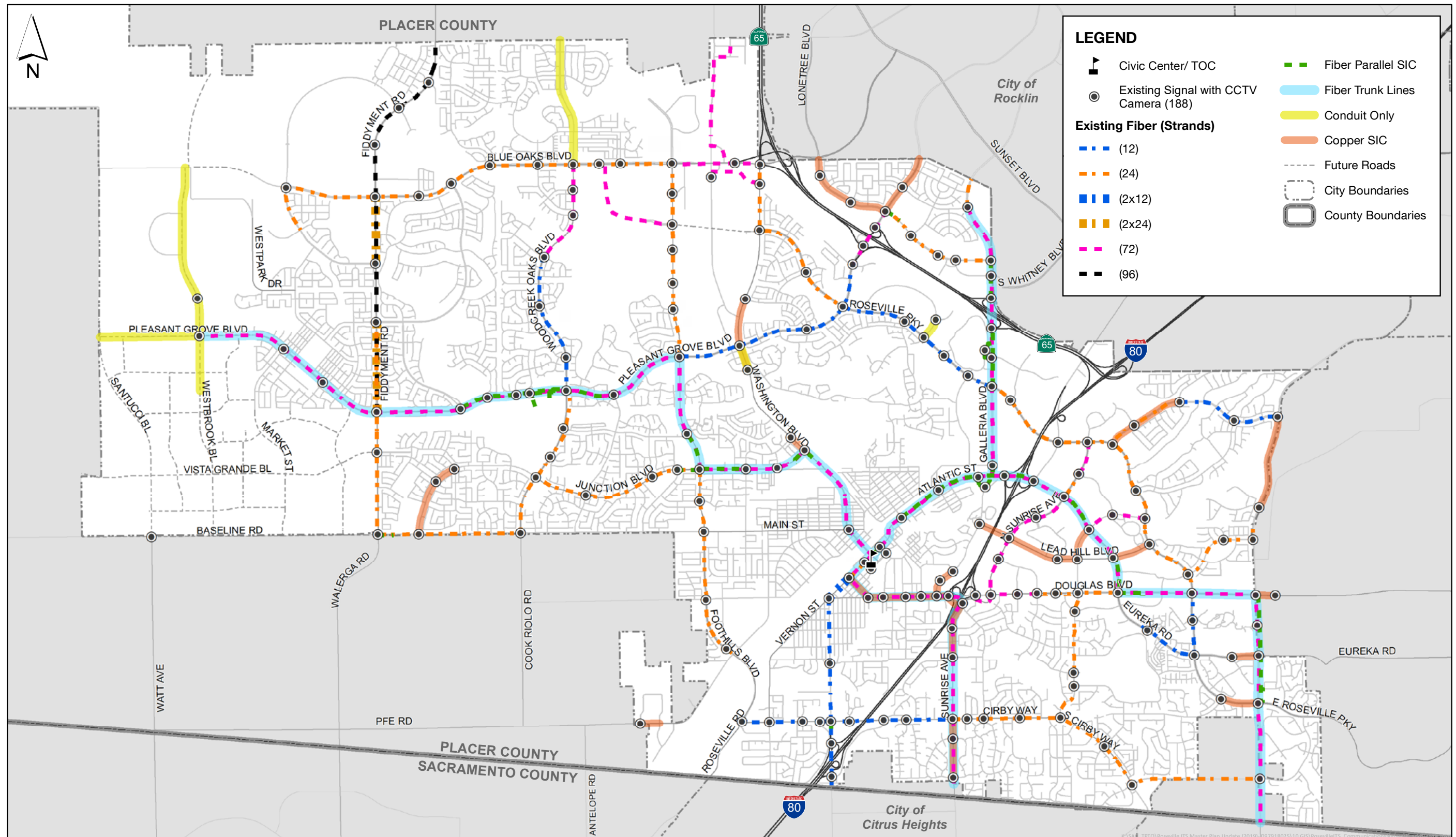
Emergency vehicle preempt (EVP) systems are provided at all City owned and maintained traffic signals. The existing EVP detector units are primarily the legacy Opticom infrared (IR) system manufactured by GTT.

B. Communications Network

The City’s existing communications network consists of a combination of fiber optic cable and legacy copper signal interconnect cable. The City’s fiber optic network currently includes a combination of 72- and 144-strand fiber optic cable trunk (backbone) spanning 18.3 miles along segments of Pleasant Grove Boulevard, Foothills Boulevard, Junction Boulevard, Washington Boulevard, Atlantic Street, Douglas Boulevard, Eureka Road, Sunrise Avenue, Galleria Boulevard, and Sierra College Boulevard. There is legacy copper traffic signal interconnect cable along various arterial and collector roadways which provides communications between the City’s TOC and connected traffic signals.

Figure 3 presents the City’s existing communications network.

Figure 3 – Traffic Signals and Existing Communications Network



A. Closed Circuit Television (CCTV) Cameras

All existing City owned and maintained traffic signals have CCTV cameras. Additionally, there are 5 CCTV camera locations not at a traffic signal located within the City. There are various types and models of CCTV cameras currently being used, many of which provide pan-tilt-zoom (PTZ) capabilities.

Figure 2 presents the locations of the existing CCTV cameras.



B. Changeable Message Signs (CMS)

The City currently owns and maintains nine (11) changeable message signs (CMS) located within the City. The City uses the CMS to provide traveler information including traffic congestion, special events, construction related road closures, and alternate routes.

Figure 2 presents the locations of the existing CMSs.



C. Wifi Readers

The City currently owns and maintains forty-five (45) wifi reader units located throughout the City. The wifi readers collect continuous traffic data used to collect traffic volumes, origin-destination, speeds, occupancy, calculate travel time, and perform other analytics functions. The current City standard wifi unit is manufactured by Acyclica.

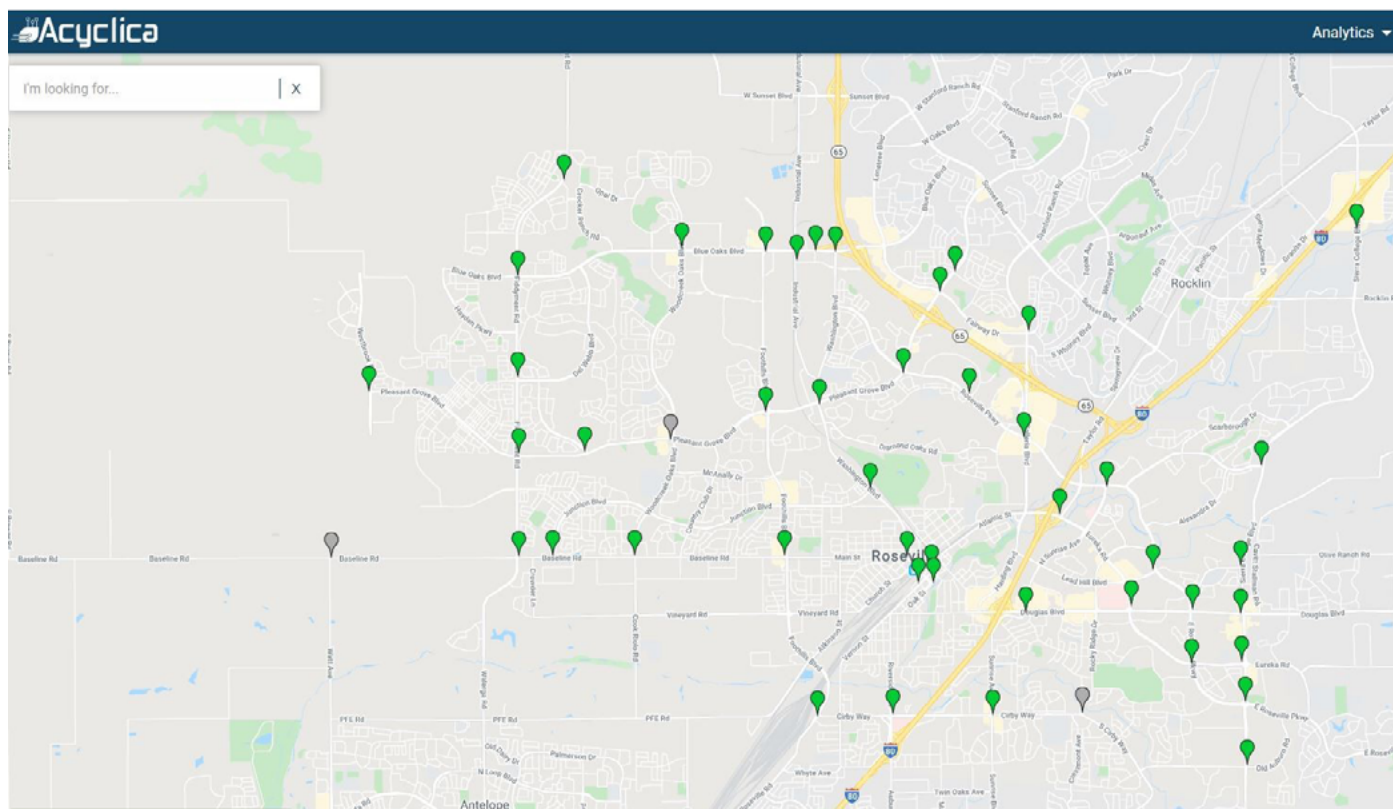




Figure 4 presents the locations of the existing wifi readers.

D. Traffic Operations Center

The City’s Traffic Operations Center (TOC) is located downtown in the Roseville Civic Center. The TOC has space for up to seven (7) traffic operations staff. The TOC includes a video wall comprised of fifteen (15) monitors from which staff are capable of monitoring and managing the various components of the City’s transportation system. City staff are currently responsible for routinely monitoring the system; however, the system is not monitored on a full-time basis.

Additionally, the City has a backup TOC located in the City’s Corporation Yard. The backup TOC includes a video wall comprised of two (2) monitors with one workstation.

Traffic Operations Center (Civic Center)

Backup TOC (Corporation Yard)

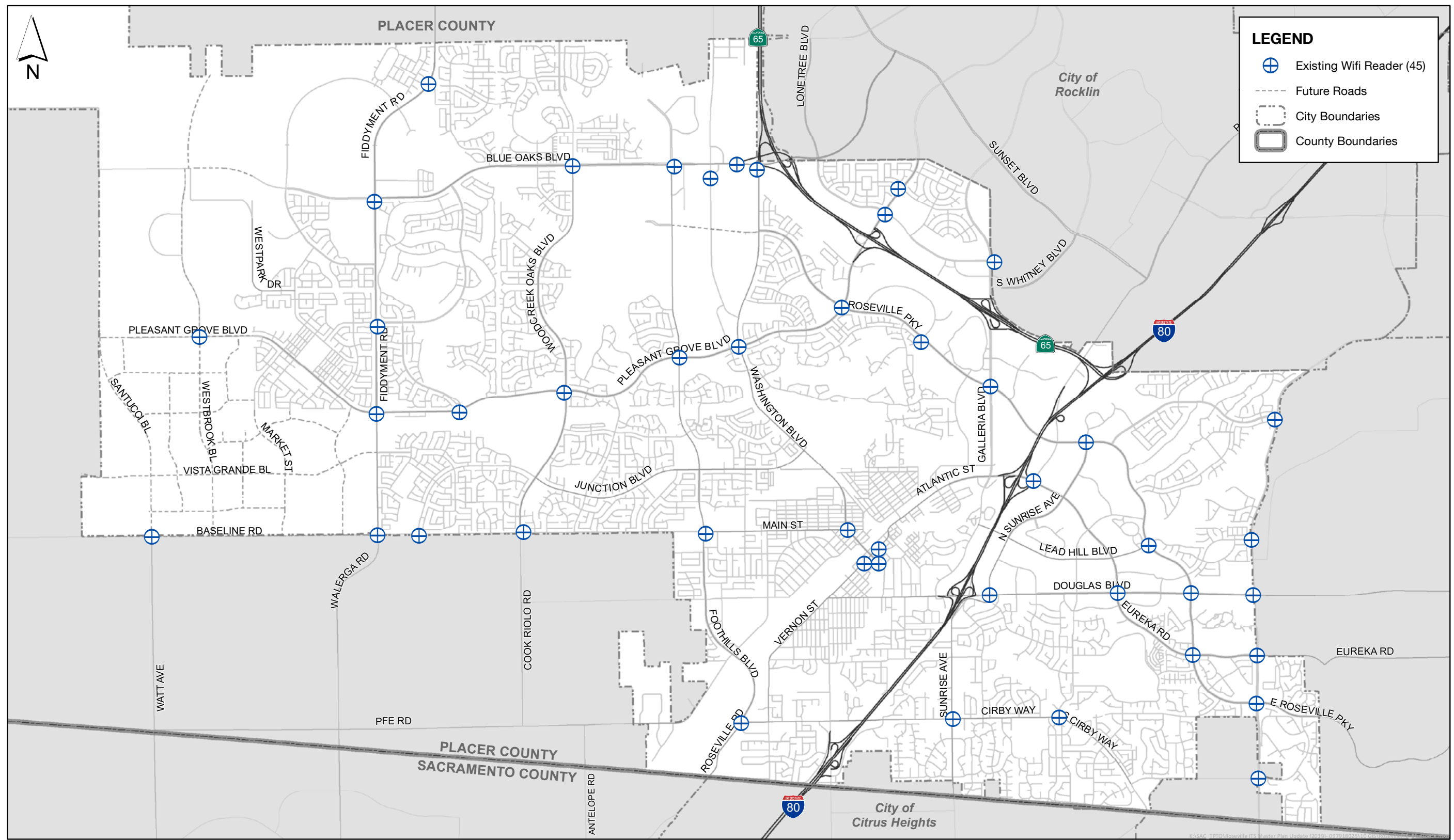


E. System Needs and Gaps Assessment

The City of Roseville’s Needs and Gaps Assessment process was conducted using a combination of methods. Existing documents and plans related to transportation and technology relevant to the City and the region were thoroughly reviewed. These needs and gaps form the foundation for identifying project solutions.

There are several gaps identified which prevent the City from addressing its traffic operations and management goals identified above. Table 2 provides a summary of the system needs and gap analysis. Also shown are the ITS goals associated with the goals and objectives identified.

Figure 4 – Existing Wifi Readers



IV ENVISIONING OF ITS TECHNOLOGIES

There are many directions that the City could move toward in implementing ITS solutions to address the needs and gaps identified. While some gaps point to specific types of strategies that will directly and completely address that gap, other gaps are more difficult to solve and will require a combination of infrastructure, operations, and institutional processes to be implemented to completely address the gap.

Traffic operations and management technology is constantly advancing and evolving, which makes it an important consideration during the formulation of implementation strategies. It is crucial that the implementation process takes full advantage of the existing ITS technologies available while also formulating strategies that align with where technological advancements are heading. This section includes brief technical discussions of the various ITS technology solutions identified for consideration in this ITS Master Plan. The technologies have been prioritized based on the City's communicated goals and needs, as well as cost and feasibility, and have been categorized below into Near-Term (0-5 year horizon), Mid-Term (5-10 year horizon), and additional technology solutions for future consideration. For each near- and mid-term technology solution identified, a technical overview is provided.

Table 3 summarizes a menu of potential ITS technology solutions.

Table 2 – Needs and Gaps Summary

ID	Need	Gap	Associated ITS Goal
1	Baseline communications infrastructure	Closing the gaps in Roseville's communications network will create redundancy in the City's communications, and replacing legacy copper communications with fiber will result in a more robust communications network.	B, C, D
2	Adequate bandwidth in communications to support data sharing	Limited bandwidth to support future technology deployments, future growth/ ultimate buildout, and expanded data sharing capabilities among other City departments. City ATMS.now is not equipped to incorporate a variety of data large enough to receive automated alert notifications.	B, C, D
3	High-resolution traffic data for real-time operational decision making	Lack of performance measurement and data analytics capabilities (i.e., ATSPM software).	B
4	Share data between agencies that share a corridor	Lack of real-time or planned knowledge of corridor restrictions to operate efficiently across jurisdictions. Lack of regional data sharing policies and guidelines to establish data sharing protocol.	F
5	Real-time traveler information	Limited real-time traveler information available to public and limited methods to disseminate information. Limited CMS equipment for communication of traveler information.	D



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ID	Need	Gap	Associated ITS Goal
6	CV/AV technology readiness	Infrastructure and systems are not currently able to support CV/AV deployments or data. Traffic signal controllers are not equipped to support CV infrastructure.	B, D
7	Trained traffic operations staff to support citywide operations	Lack of sufficient number of staff members dedicated to traffic operations for day-to-day monitoring.	E
8	Share regional operations and maintenance responsibilities	Agencies conducting traffic operations and maintenance independently causes lack of traffic coordination; lack of adequate staffing; lack of regional maintenance contract.	F
9	Improve arterial traffic operations	Automate some functions to streamline operations. Current lack of adaptive traffic control and traffic signal coordination along key corridors.	B
10	Improve special event coordination	Lack of coordination to support better mobility during special events. This includes lack of TNC zones for last-mile connections.	B, D, F
11	CV/AV policy readiness	Policies and codes currently do not support CV/AV.	B, D
12	Funding strategy	Lack of reliable funding mechanism to support Smart City or Smart Region initiatives on a regional or agency-by-agency basis.	F

Table 3 – ITS Technology Solutions Matrix

Near-Term (0-5 Year Horizon)	Mid-Term (5-10 Year Horizon)	Technology Solutions for Future Consideration
N1. Big Data	M1. Automated Functions	L1. Multi-Systems Operator
N2. Connected and Autonomous Vehicle (CAV) Technology	M2. CCTV Camera Audio Capabilities	L2. Increased Use of Social Media
N3. Network Failover and Redundancy	M3. Bus Rapid Transit and Transit Signal Priority	L3. CCTV Camera View Shed and Resolution
N4. Automated Traffic Signal Performance Measures (ATSPM)	M4. Automated Pedestrian Detection	L5. Deployment of Citywide Wi-Fi Network
N5. Transportation Network Carriers (TNCs)	M5. Field Hubs for Specific Plan Areas	L6. Pollution Monitoring
N6. Mobile Applications		L8. Congestion Pricing
N7. Crash Detection Systems		L9. Regional System Redundancy
		L10. Trailblazers

A. Near-Term Solutions

The following ITS technology technologies or strategies were identified as near-term solutions.

- **Big Data** is becoming more readily available as more data is acquired from connected field infrastructure on a near-real-time-basis, as well as additional data-rich information from new sources such as probe vehicles, fleet vehicles, and connected vehicles becomes more mainstream. Big Data is about predictive analytics; or more simply, improving our ability to predict and anticipate outcomes. Historically, transportation data has been difficult and costly to obtain, but as it becomes increasingly available through global positioning location tracking, phone apps, and many other sources this is quickly changing. Big Data is already changing the way we plan, analyze, and operate our transportation network, and it is envisioned that big data will play a large role in affecting the evolution of the Sacramento Transportation Area Network (STARNET).
- **Connected Vehicle (CV)** readiness, both in terms of infrastructure and institutions, was identified as a need and yet full connected vehicle CV deployment is gradually becoming a reality in the industry. As a result, it is important that the partner agencies are equipped with the infrastructure and projects needed to adapt to those changes and needs. It is important to recognize the changing landscape of technology options with connected vehicles because the federal guidelines have not been finalized. Agency adoption of providing data to or collecting data from a connected vehicle will need to have benefits outlined and likely deployed on a scalable basis until more formal guidelines for adoption and expectations are defined.
- **Autonomous Vehicle (AV)** readiness, in terms of institutions and policies, was identified as a need as AVs are being tested on more and more roadways throughout the Country. Although functioning autonomously, there may be a variety of useful data that could be provided to the vehicle, collected by the vehicle, or shared between AVs that could require an agency role and responsibility.
- **Network Failover and Redundancy** involves the concept of providing communications redundancy to establish independent, secondary communications links between two or more points on a network. Redundancy can take the form of physical infrastructure (e.g., additional fiber routes within a ring or mesh network), communications equipment (e.g., backup switch ports or backup NICs), or secondary communications links (e.g., leased wireless connections at hub points). In a fiber (or copper) network, redundancy is accomplished by assigning and terminating fiber strands or copper pairs at central or hub points to serve as a back-up (or failover) communications link in the event that the primary link is broken or fails to communicate, or experiences excessive latency. The failover operations can be automatic (e.g., dual ring configuration in SONET or Ethernet networks) or manual where the fibers or copper pairs are patched over manually when a fault has been detected. As described above, it is also possible to use different media as a redundant link. For example, a fiber or copper link could have a wireless link as a redundant circuit.

Deploying additional redundancy with the City's network, in conjunction with the continued buildout of the City's fiber backbone, will be further evaluated and planned as part of this ITS Master Plan. Individual links and projects will be identified for the City to deploy to achieve network redundancy. The City already has a substantial communications network, so the deployment of a redundant system will be cost-effective. This redundancy will primarily involve upgrading central equipment and splicing fibers to create the secondary links. Projects in this ITS Master Plan will identify opportunities to create network redundancy.

- **Automated Traffic Signal Performance Measures (ATSPM)** is a software module add-on to many traffic signal software applications that processes and analyzes traffic signal data to display and report performance metrics of an individual traffic signal, corridor, and/or across the traffic signal network. This feature enables agencies to proactively identify trouble areas, report on corridor performance, and facilitate efficient traffic management. Deployment of ATSPMs should be considered to allow the City to utilize high-resolution data from existing detection technology to more effectively manage the traffic signals along arterial roadways and/or larger roadway networks within the City.
- **Transportation Network Carriers (TNCs)** – TNCs pair passengers with drivers who provide on-demand service, most often via websites or mobile apps. Services such as Uber and Lyft are examples of the sharing economy. Increasingly, transit providers, including Roseville Transit, are beginning to provide on-demand transportation services to augment their systems. These services have the potential to address the long-standing challenge of first-mile, last-mile service to expand the reach of existing bus and light rail service.
- **Mobile Applications** has had an increasing presence in the way transportation-related information is disseminated and obtained. The development of mobile applications for use on smart phones or tablets has provided a channel through which transportation agencies can push information to system users (internal and external). Applications can be developed by agency staff, public, and/or private developers on platforms such as Apple iOS and Android. These applications, built using an Application Programming Interface (API), have a range of possibilities. For drivers, mobile applications could include real-time transit information (e.g., bus arrivals and departures), traffic notifications and alerts, and interactive trip planners. Development of mobile applications can be done through in-house effort (by the City) or by contracting private developers.

Mobile applications are a popular way to make traveler information available to the public in a consolidated and easily accessible manner. The City should always be considering opportunities to provide information through a mobile application, but should further investigate how the application would be developed and where it would reside. Mobile applications for internal City use could be very beneficial for remote access to TOC functionality as described above. The City should consider conducting a needs assessment to evaluate the feasibility, importance, and relevance of mobile applications, starting with a maintenance monitoring application.

- **Crash Detection Systems**, for automated vehicle accident detection, is an important technology to local agencies and municipalities because rapid response is the most effective tool to reducing fatalities and delay that may occur due to traffic incidents. Technology used for automatic accident recognition can include inductive loop sensors, radar sensors, and video recognition software. Other incident alert systems utilize information provided by the California Highway Patrol computer aided dispatch reports to identify locations of accidents. Research is being conducted on a variety of technologies for future applications towards accident detection, warning, and avoidance. These developing technologies include inter-vehicular communications (i.e. U.S. Department of Transportation's IntelliDriveSM program), global positioning systems (GPS), and mobile phone tracking.

Several of the above mentioned technologies can utilize systems already employed by local agencies. Software that can be programmed to recognize traffic accidents is available and can be integrated with existing CCTV camera systems. The recognition software can be programmed to send alerts in the event of an identified vehicle crash. To implement the crash detection software, central server upgrades may be required to run the program. Other detection technology, like existing presence loops at intersections, can be utilized to identify sudden increases in volumes that may be attributed to incidents. Mid-block sensors (radar, inductive loops, microwave detectors, etc.) may be necessary to monitor traffic away from intersections. This technology is currently on the cutting edge and requires cooperation with vehicle manufacturers, system integrators, DOTs, local agencies, and consultants. The City should monitor the continued development of this technology and look for opportunities for pilot tests at critical intersections where safety is an issue.

B. Mid-Term Solutions

The following ITS technology technologies or strategies were identified as potential mid-term solutions.

- **CCTV Camera Audio Capabilities** would allow use of audio for enhanced surveillance capabilities by TOC staff and police departments. Additionally, this would allow for communication between a TOC and technicians in the field during maintenance activity and traffic incident alerts. Many of the CCTV camera systems utilize an external microphone and speakers each connected to the CCTV camera or video encoder through stereo jacks. The City of Roseville currently has PTZ cameras installed at each signalized intersection. Video encoders can be used to transmit camera audio, but the City's existing encoders do not have the necessary connector ports to connect to audio components (i.e. microphones and speakers). New encoders would be required to transmit one-way or two-way audio. Before the implementation of any audio equipment, tests should be conducted to measure the quality and usability of the audio that could be captured.
- **Bus Rapid Transit and Transit Signal Priority** is used to increase transit ridership and total operating cost by reducing bus travel times and improving on-time bus performance (i.e., reliability) through minimizing delay at the signalized intersections. "Full BRT" systems accomplish this purpose by providing separate bus only travel lanes and bus stop facilities. These "full BRT" systems operate in a similar fashion as light rail systems with drastically reduced implementation and operation costs. Agencies that are unable to implement a "full BRT" system due to roadway or other infrastructure constraints have deployed BRT that heavily rely on TSP to provide operational improvements. Traffic signal equipment to be used for TSP operations can work with the same equipment that allows emergency vehicles to communicate with traffic signals. However, unlike the "high priority" emitters used by emergency vehicles, buses use "low priority" emitters which increases the likelihood that the BRT buses will not stop at the signal but it is not guaranteed.

While the City has TSP systems in place at many signalized intersections, the majority of the existing systems utilize legacy infrared (IR) technology. It is recommended that the City replace the existing IR based system with newer generation GPS technology TSP solutions which is more effective. Also, as transit ridership increases and the need arises in the future, BRT should be considered along key arterial routes to provide enhanced transit service for residents and visitors.

- **Automated Pedestrian Detection** is the deployment of equipment (often video or radar) to monitor pedestrians as they cross an intersection. This equipment is connected to a traffic signal controller and will extend a “Flashing Don’t Walk” and associated green phase to allow the pedestrians to fully cross an intersection before the conflicting approach receives a green. This technology would benefit pedestrians who walk at slower speeds and would enhance safety by allocating additional time to safely cross the street. The City should consider deployment of Automated Pedestrian Detection technology at intersections with high pedestrian activity, or areas that may have a need for periodic extension of the pedestrian phase (such as near schools or senior centers).
- **Field Hubs for Specific Plan Areas** would provide central communication points to which various branch communication lines and field devices are connected. Field hubs are used to collect and multiplex field device data, then transmit the data directly to the TMC over the fiber trunk lines, thereby reducing overall network traffic and optimizing the use of the available fiber. The City currently has communication hubs near the specific plan areas at the western extents of Roseville (at the intersections of Fiddymont/Pleasant Grove, Fiddymont/Blue Oaks, and Blue Oaks/Hayden). When the future specific plan areas are being developed and/or the City begins to upgrade existing fiber lines near those areas, new field hubs may be needed at major intersections of fiber corridors. The new hubs will provide additional network capacity to support all the new traffic signals and cameras anticipated in the specific plan areas.



ITS MASTER PLAN UPDATE

V PLAN IMPLEMENTATION

This section presents individual implementable projects based on identification of strategic corridors and technologies. The projects have been identified by focusing on enhancing the City of Roseville’s existing ITS infrastructure while considering the priorities and goals of the City. The intent of this section is to provide a list of manageable, modular projects that can be deployed as project funds become available. Each project includes details of the recommended project with estimated planning level costs for project development and capital.

A. Specific Projects

Table 4 contains a list of specific projects that directly address the City’s priorities and needs. The methodologies and assumptions for developing the list of projects are as follows:

Communication Upgrade Projects – As identified in the technology evaluation section, a top priority of the City is to continue buildout of its fiber optic network and develop additional network redundancy. Many of the communication upgrade projects focus on creating redundancy within the City’s existing communications network, or upgrading existing copper interconnect to fiber to provide enhanced network capacity. Creating fiber communication rings will rely on splicing and configuring the existing fiber lines. In addition to existing communication system upgrades, projects are presented that will provide the necessary backbone for future specific plan developments such as in West Roseville. Lastly, projects are proposed that will create hard-wired communication connections to existing or future traffic signals. Planning level costs for new fiber communication is per mile of installed fiber and assumes installation costs of two, 3-inch conduits, fiber-optic cable, pull boxes every 400-feet, two splice boxes per corridor, and two fiber switches. Cost assumptions for upgrading existing communication lines to 72-strand fiber only assumes new fiber, new network switches, and splices for each upgraded segment. The communication projects listed in **Table 4** are also graphically presented in **Figure 5**.

Wifi Travel Time Corridors – Several key corridors have been identified as potential travel time corridors based on existing signal coordination. An added benefit of installing wifi technology along the same corridors with signal coordination and advanced/predictive signal control is that the wifi stations may be used to measure the performance of the coordination and advanced/predictive control. To provide adequate travel times with travel speed information by segment, a wifi unit is assumed at each signalized intersection along a corridor and the project planning costs reflect this assumption. The City of Roseville has identified a total of 27 new locations for wifi reader deployment in the future. This recommended deployment, which would expand the City’s current and established wifi reader network, is depicted in **Figure 6**.

Changeable Message Signs – The City of Roseville currently has deployed CMSs in advance of key strategic decision locations to relay traveler information that may include incident and special event information. As presented in **Table 4**, additional CMS are recommended for in-fill locations to expand the current CMS system. The CMS locations proposed were chosen because they are on major arterial routes where drivers can be directed to Hwy 65 or I-80 depending on real-time traffic conditions. The City of Roseville has identified 10 locations for CMSs to be installed in the future. These future CMSs are assumed to have the same form and function as the existing CMSs deployed throughout the City.

Traffic Signals – The City of Roseville has already identified 52 traffic signals to be installed in the future due to future development and traffic demands under future buildout conditions. The recommended deployment of future traffic signals, along with CCTV cameras, and CMSs is depicted in **Figure 7**.



Table 4 – Project List

Infrastructure Projects										
Project ID	Project Description	New Signal (including Video Detection)	Number of Wireless Radio (Intersection)	New CCTV Cameras	New Bluetooth Readers	New CMS	Communication (Miles)			Planning Level Cost
							New	In Empty	Replace/Upgrade	
Communication Gap Closures, Communications Equipment Upgrade, Upgrade to Fiber										
1a	<ul style="list-style-type: none"> Baseline Rd - Watt Ave to Walerga Rd/Fiddymment Rd New 72-strand fiber (New Conduit) 	7		7	0	2	1.84			\$5,699,000
1b	<ul style="list-style-type: none"> Fiddymment Rd - Vista Grande Blvd to Basline RD New traffic signals with video detection cameras and CCTV 	2		2	3	0				\$1,058,000
2	<ul style="list-style-type: none"> Westbrook Blvd - Pleasant Grove Blvd to Baseline Rd New 72-strand fiber (New Conduit) 	4		4	0	0	1.21			\$3,492,000
3	<ul style="list-style-type: none"> Baseline Rd - Blue Oaks Blvd to Vista Grande Blvd New 72-strand fiber (Existing Conduit) 	4		4	3	0		1.82		\$2,875,000
4	<ul style="list-style-type: none"> Blue Oaks Blvd - Westbrook Blvd to Hayden Pkwy New 72-strand fiber (New Conduit) 	0		0	0	0	0.87			\$761,000
5	<ul style="list-style-type: none"> Pleasant Grove Blvd - Santucci Blvd to Chandler Ave Upgrade SIC to 72-strand fiber (Existing Conduit) 	4		4	3	0	1.13			\$3,089,000
6	<ul style="list-style-type: none"> Santucci Blvd - Pleasant Grove Blvd to Baseline Rd (Future) New 24-strand fiber (New Conduit) 	4		4	0	0	1.74			\$3,610,000
7	<ul style="list-style-type: none"> Vista Grande Blvd - City Limits to Fiddymment Rd (Future) New 24-strand fiber (New Conduit) 	5		5	2	0	2.33			\$4,663,000
8	<ul style="list-style-type: none"> Sierra Village Dr - Westbrook Blvd to Baseline Rd (Future) New 24-strand fiber (New Conduit) 	0		0	0	0	0.82			\$717,000
9	<ul style="list-style-type: none"> Upland Dr - Vista Grande Blvd to Baseline Rd (Future) New 24-strand fiber (New Conduit) 	0		0	0	0	0.59			\$517,000
10	<ul style="list-style-type: none"> Blue Oaks Blvd - City Limits to Westbrook Blvd New 24-strand fiber (New Conduit) 	2		2	0	0	0.73			\$1,681,000
11	<ul style="list-style-type: none"> Westbrook Blvd - City Limits to Blue Oaks Blvd New 24-strand fiber (New Conduit) 	2		2	0	0	0.80			\$1,744,000
12a	<ul style="list-style-type: none"> Blue Oaks Blvd - Hayden Pkwy to Foothills Blvd Upgrade to 72-strand fiber (Existing Conduit) 	1		1	0	1			3.22	\$1,333,000
12b	<ul style="list-style-type: none"> Hayden Pkwy - Blue Oaks Blvd to Fiddymment Rd New traffic signals with video detection cameras and CCTV 	2		2	0	0				\$1,044,000
13	<ul style="list-style-type: none"> Pleasant Grove Blvd - Foothills Blvd to Highland Pointe Dr Upgrade to 72-strand fiber (Existing Conduit) 	0		0	0	5			1.79	\$669,000
14a	<ul style="list-style-type: none"> Baseline Rd - Fiddymment Rd to Woodcreek Oaks Blvd, Woodcreek Oaks Blvd - Baseline Rd to Junction Blvd Upgrade to 72-strand fiber (Existing Conduit) 	0		0	0	0			1.66	\$393,000
14b	<ul style="list-style-type: none"> Baseline Rd at Country Club Dr New traffic signal with video detection cameras, CCTV, and wireless radio 	1	1	1	0	0				\$527,000



Infrastructure Projects										
Project ID	Project Description	New Signal (including Video Detection)	Number of Wireless Radio (Intersection)	New CCTV Cameras	New Bluetooth Readers	New CMS	Communication (Miles)			Planning Level Cost
							New	In Empty	Replace/Upgrade	
Communication Gap Closures, Communications Equipment Upgrade, Upgrade to Fiber										
14c	<ul style="list-style-type: none"> Junction Blvd - Woodcreek Oaks Blvd to Foothills Blvd Upgrade to 72-strand fiber (Existing Conduit) 	0		0	0	0			1.42	\$337,000
14d	<ul style="list-style-type: none"> Foothills Blvd - Junction Blvd to Atkinson St Upgrade to 72-strand fiber (Existing Conduit) 	0		0	0	0			1.58	\$377,000
15	<ul style="list-style-type: none"> Foothills Blvd - Atkinson St to Cirby Way New 72-strand fiber (New Conduit) 	0		0	0	0	0.64			\$556,000
16	<ul style="list-style-type: none"> Woodcreek Oaks Blvd - Blue Oaks Blvd to City Limits New 24-strand fiber (Existing Conduit) 	2		2	0	0		1.02		\$1,287,000
17a	<ul style="list-style-type: none"> Woodcreek Oaks Blvd - Pleasant Grove Blvd to Horncastle Ave Upgrade to 24-strand fiber (Existing Conduit) 	0		0	3	0			1.15	\$288,000
17b	<ul style="list-style-type: none"> Woodcreek Oaks Blvd - Blue Oaks Blvd to Pleasant Grove Blvd New Bluetooth Readers 	0		0	2	0				\$9,000
18a	<ul style="list-style-type: none"> Junction Blvd - Baseline Rd to Park Regency Dr Upgrade SIC to 24-strand fiber (Existing Conduit) 	0		0	0	0			0.64	\$153,000
18b	<ul style="list-style-type: none"> Junction Blvd - Baseline Rd to Woodcreek Oaks Blvd New Bluetooth Reader 	0		0	1	0				\$5,000
19a	<ul style="list-style-type: none"> Washington Blvd - Hallissy Dr to Diamond Oak Rd Upgrade SIC to 24-strand fiber (Existing Conduit) 	1		1	0	0			0.60	\$664,000
19b	<ul style="list-style-type: none"> Washington Blvd at All American City Blvd New traffic signal with video detection cameras and CCTV 	1		1	0	0				\$522,000
20	<ul style="list-style-type: none"> Washington Blvd - Diamond Oak Rd to Kaseberg Dr New 24-strand fiber (New Conduit) 	0		0	0	0	0.46			\$402,000
21a	<ul style="list-style-type: none"> Washington Blvd - Kaseberg Dr to Junction Blvd Upgrade SIC to 24-strand fiber (Existing Conduit) 	0		0	1	0			0.37	\$92,000
21b	<ul style="list-style-type: none"> Junction Blvd - Foothills Blvd to Washington Blvd New Bluetooth Reader 	0		0	1	0				\$5,000
22a	<ul style="list-style-type: none"> Washington Blvd - Blue Oaks Blvd to Roseville Pkwy Upgrade to 72-strand fiber (Existing Conduit) 	0		0	1	0			0.54	\$132,000
22b	<ul style="list-style-type: none"> Industrial Ave - Blue Oaks Blvd to Justice Center Dr New traffic signals with video detection cameras and CCTV 	2		2	0	0				\$1,044,000
23a	<ul style="list-style-type: none"> Roseville Pkwy - Washington Blvd to Pleasant Grove Blvd Upgrade to 72-strand fiber (Existing Conduit) 	0		0	0	0			0.98	\$234,000
23b	<ul style="list-style-type: none"> Roseville Pkwy at Gibson Dr New traffic signal with video detection cameras and CCTV 	1		1	0	0				\$522,000
24	<ul style="list-style-type: none"> Fairway Dr - Blue Oaks Blvd to Stanford Ranch Rd/Galleria Blvd Upgrade SIC and existing fiber to 72-strand fiber (Existing Conduit) 	1		1	0	0			1.79	\$948,000
25	<ul style="list-style-type: none"> Pleasant Grove Blvd - Fairway Dr to City Limit Upgrade SIC to 72-strand fiber (Existing Conduit) 	0		0	0	0			0.51	\$122,000



Infrastructure Projects										
Project ID	Project Description	New Signal (including Video Detection)	Number of Wireless Radio (Intersection)	New CCTV Cameras	New Bluetooth Readers	New CMS	Communication (Miles)			Planning Level Cost
							New	In Empty	Replace/Upgrade	
Communication Gap Closures, Communications Equipment Upgrade, Upgrade to Fiber										
26	<ul style="list-style-type: none"> Lead Hill Blvd - Harding Blvd to Rocy Ridge Dr Rocky Ridge Dr - Lead Hill Blvd to Eureka Rd Upgrade SIC to 72-strand fiber (Existing Conduit) 	0		0	2	0			1.13	\$278,000
27a	<ul style="list-style-type: none"> Cirby Way - Roseville Rd/Foothills to Old Auburn Rd Upgrade to 72-strand fiber (Existing Conduit) 	2		2	2	1			3.41	\$1,909,000
27b	<ul style="list-style-type: none"> Sunrise Ave at Sandringham Way (City Limits) New Bluetooth Reader 	0		0	1	0				\$5,000
27c	<ul style="list-style-type: none"> Old Auburn Rd - Cirby Way to Sierra College Blvd Upgrade to 72-strand fiber (Existing Conduit) 	1		1	0	0			1.05	\$772,000
28	<ul style="list-style-type: none"> Gibson Dr - Roseville Pkwy to Conference Center Dr New 24-strand fiber (Existing Conduit) 	0		0	0	0		0.18		\$43,000
29a	<ul style="list-style-type: none"> Secret Ravine Pky - E Roseville Pkwy to Scarborough Dr Upgrade SIC to 24-strand fiber (Existing Conduit) 	0		0	0	1			0.66	\$202,000
29b	<ul style="list-style-type: none"> Roseville Pkwy at Taylor Rd New Bluetooth Reader 	0		0	1	0				\$5,000
30	<ul style="list-style-type: none"> Sierra College Blvd - E Roseville Pkwy to Miners Ravine Dr Upgrade SIC to 24-strand fiber (Existing Conduit) 	0		0	0	0			0.76	\$182,000
31	<ul style="list-style-type: none"> Lead Hill Blvd - Eureka Rd to E Roseville Pkwy Upgrade SIC to 24-strand fiber (Existing Conduit) 	0		0	0	0			0.32	\$76,000
32	<ul style="list-style-type: none"> Harding Blvd - Douglas Blvd to Estates Dr Upgrade SIC to 24-strand fiber (Existing Conduit) 	0		0	0	0			0.26	\$63,000
33	<ul style="list-style-type: none"> Eureka Rd - Ashland Dr to Sierra College Blvd Upgrade SIC to 24-strand fiber (Existing Conduit) 	0		0	0	0			0.22	\$52,000
34a	<ul style="list-style-type: none"> E Roseville Pkwy - Sierra College Blvd to Old Auburn Rd New 24-strand fiber (New Conduit) 	1		1	0	0	0.39			\$860,000
34b	<ul style="list-style-type: none"> Sierra College Blvd - E Roseville Pkwy to Old Auburn Rd New traffic signal with video detection cameras and CCTV 	1		1	0	0				\$522,000
34c	<ul style="list-style-type: none"> E Roseville Pkwy - N Cirby Way to Sierra College Blvd Upgrade SIC to 24-strand fiber (Existing Conduit) 	0		0	0	0			0.30	\$72,000
Additional Projects										
35	<ul style="list-style-type: none"> Angus Rd at Casa Sedona Dr New traffic signal with video detection cameras, CCTV, and wireless radio 	1	1	1	0	0				\$527,000
36	<ul style="list-style-type: none"> Vernon St at Douglas Blvd New Bluetooth Reader 	0		0	1	0				\$5,000
Totals:		52	2	52	27	10	14	3	24	\$47,144,000

Figure 5 – Ultimate Communications Deployment

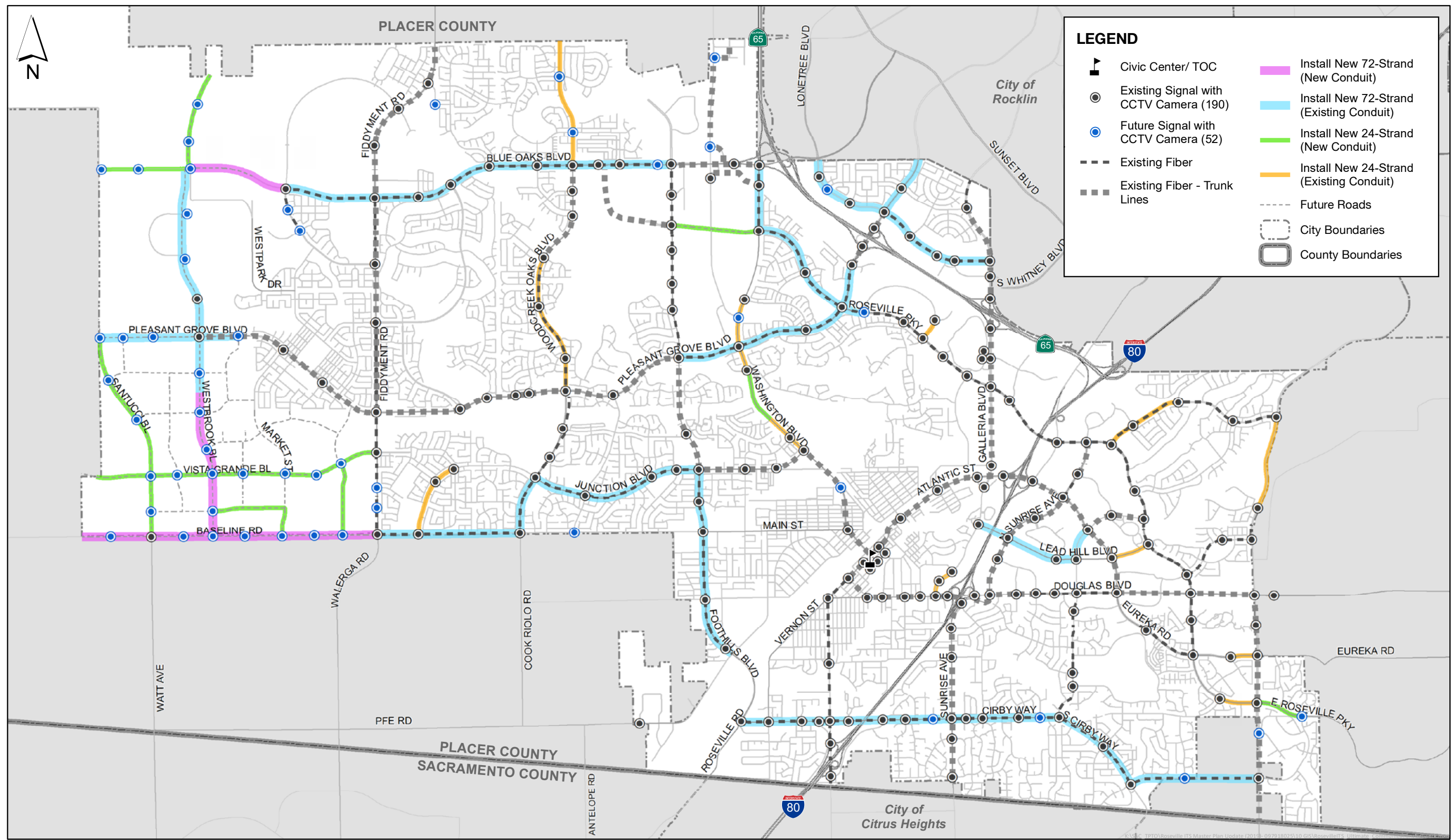


Figure 6 – Ultimate Wifi Reader Deployment

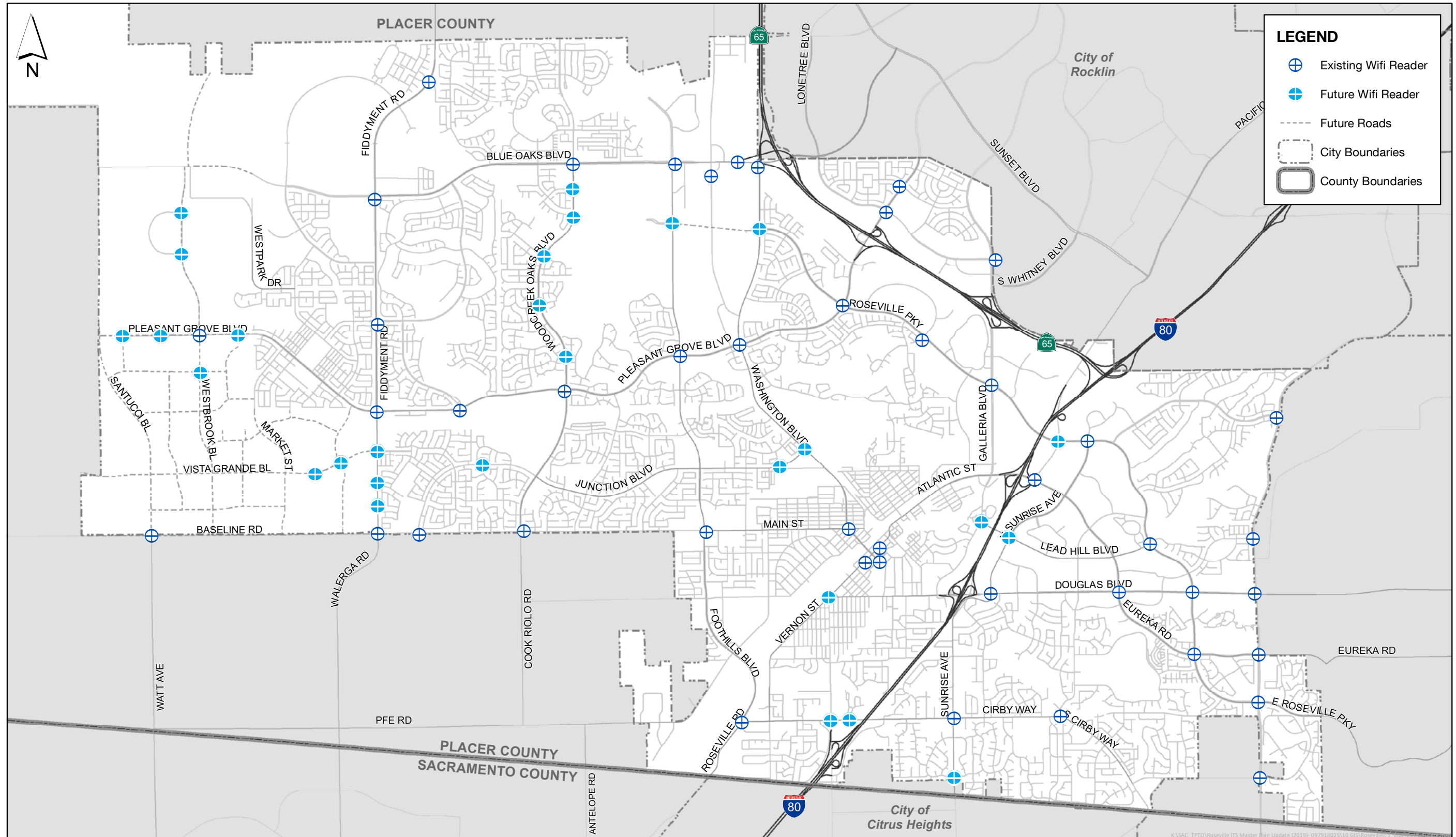
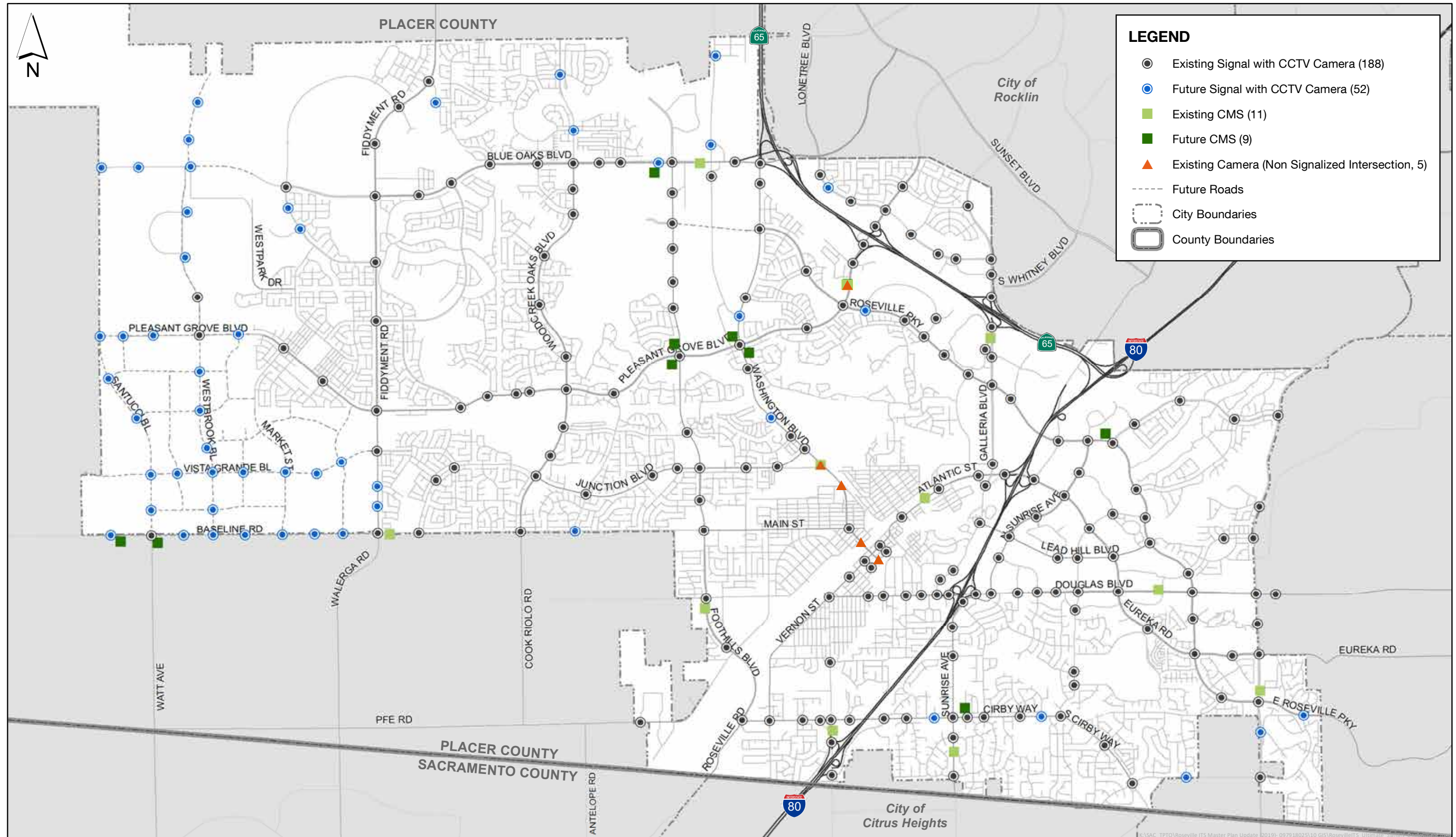


Figure 7 – Ultimate Signal, CCTV, and CMS Deployment





B. Cost Estimations

Planning level cost estimations were prepared to reflect an order-of-magnitude costs for each project. The cost information is a planning-level estimate to deploy each project, based on available current (2019) pricing information for similar technology projects in the region, and includes cost associated with project development, design, construction, integration, and operations and maintenance costs.



ITS MASTER PLAN UPDATE

VI OPERATIONS AND MAINTENANCE

To effectively operate and maintain the various project elements and projects identified in this ITS Master Plan, the City of Roseville must be adequately staffed and prepared to sustain the system after it is deployed. Operations and maintenance procedures are essential to define the appropriate staffing levels, training, operational processes, and maintenance plans necessary to sustain an effective system.

A. Staffing

Staffing serves the operations side of the ITS Master Plan. The successful implementation of operations strategies is largely dependent on providing appropriate staffing as related to the increase in operational capabilities.

With a population of approximately 135,000, the City of Roseville is the largest City in Placer County and one of the fastest growing cities in the region. While growth in the City is a positive, the City must make sure that it is planning for the projected growth as it takes on more projects, expands its infrastructure and services, and offers more to residents and visitors. The City has an established and robust ITS and transportation system as compared to other cities in the region. With the growth in population, the City has also experienced increased congestion levels throughout the City, especially along primary arterial roadways which provide direct access to I-80 and SR-65. The City is committed to improving the efficiency of the transportation network by leveraging its existing assets while utilizing emerging technologies to enhance the City's overall transportation system.

The inventory of transportation assets in the City has been steadily increasing and the City should review to assure sufficient staff or budget associated with operating and maintaining traffic signal and ITS deployments. This has resulted in a situation where the City is understaffed for operations and maintenance of the traffic signal and ITS field devices including network infrastructure.

The City's ITS network and TOC are managed and operated by the Traffic Operations Section of the Public works Department's Engineering Division. As depicted in Figure 8, the Traffic Operations Section is currently comprised of fourteen staff positions, including five engineers and seven technicians.

The Public Works Engineering Manager, Senior Civil Engineer, Associate Engineer, and Assistant Engineers are currently located in the TOC. There are no dedicated workstations or work areas that are strictly intended for TOC video wall use, but all staff have access to, and control of, the City's traffic signal system or information that can be displayed on the video wall or streamed to their own workstation. One TOC workstation is positioned and oriented with a prominent view of the video wall. There are two additional work spaces that are available as staff continues to expand.

The Traffic Signal Maintenance Supervisor and Electronics and Maintenance Technicians are currently located at the City's Corporation Yard. All seven of the maintenance staff located at the Corporation Yard have workstations with access to the traffic signal system and the capability of streaming video.

Figure 8 – Traffic Operations Section Organization Chart

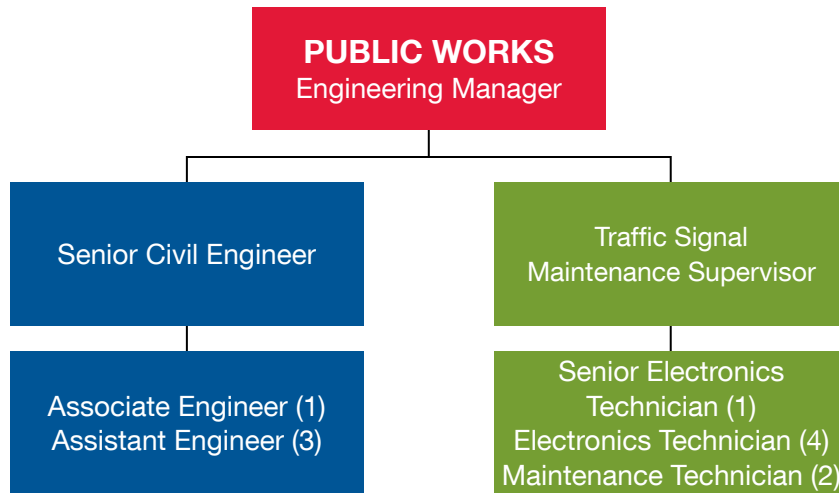


Table 5 provides recommended ratios for the number of devices or signals to warrant one staff person for small, medium, and large jurisdictions based on the total number of devices or signals the jurisdiction is expected to operate and maintain. Operations staff are responsible for daily monitoring and use of transportation management assets. Engineers are responsible for conducting analysis of system performance and developing solutions. Maintenance staff are responsible for preventative and routine servicing of field assets.

Table 5 – Staffing Ratios for Operations and Maintenance

City Size Classification	Number Of:	Small	Medium	Large
Total	Signals	< 50	50 – 200	> 200
Total	Devices	< 100	100 – 300	> 300
Recommended Staffing Ratios	Number Of:	Small	Medium	Large
Operations	Devices	25 : 1	50 : 1	75 : 1
Engineer	Devices	100 : 1	100 : 1	100 : 1
Maintenance/Technicians	Signals	40 : 1	40 : 1	40 : 1
Maintenance/Technicians	Devices	100 : 1	100 : 1	100 : 1

* Using ITE recommendations for staffing ratios per device from Traffic Control Systems Operations – Installation, Management and Maintenance which recognizes the difference between large, medium, and small agency size ratios. Values were verified to be consistent with other more recent sources such as Traffic Signal Operations and Maintenance Staffing Guidelines (FHWA-HOP-09-006) and other agency publications around the country.

With 190 traffic signals and 436 devices, the City of Roseville is considered a medium- to large-sized agency. **Table 6** provides a summary of the existing and future number of devices and staff recommendations to support the desired infrastructure and functionality envisioned through this ITS Master Plan. Full buildout assumes the addition of 52 new traffic signals and 89 new devices in the City’s transportation network based on projected future development.

Table 6 – Staffing Recommendations for the City of Roseville

	No. of Devices*	No. of Operations Staff	No. of Engineering Staff	No. of Traffic Signals	No. of Maintenance Staff (Signals)	No. of Maintenance Staff (Devices)
Existing Conditions	436	3 (140:1)	3 (140:1)	190	4 (50:1)	4 (50:1)
Full Buildout	525	7 (75:1)	5 (100:1)	242	6 (40:1)	3 (100:1)

*ITS equipment includes: traffic signals (with video detection system), CCTV cameras, CMS, and Wifi readers.

As shown, it is recommended that the City have a staff including up to 7 operations staff, 5 engineering staff, and 9 maintenance staff dedicated to maintenance of signals and all ITS devices under full buildout conditions.

Engineering staff are typically responsible for management, operations, and design; system checks; analysis and development of modifications to signal timing; collection and analysis of traffic and accident data; development and administration of contracts for the installation or modification of traffic signals and other ITS devices; and supervision of daily activities.

Operations staff are typically responsible for monitoring of real-time traffic conditions at the TOC, monitoring system and device health status, using CCTV cameras for traffic monitoring and incident verification, and implementing changes to signal timing.

Signal maintenance staff are typically responsible for the installation, diagnostics and maintenance of all electronic equipment pertaining to traffic signal operation including programming of traffic controllers, troubleshooting, replacement, and repairs. Other maintenance staff have similar responsibilities for communications systems, ITS devices (i.e., CCTV cameras, CMS, detectors, uninterrupted power supplies (UPS), data collection devices), and street lighting.

B. Maintenance Plan

Planning for ITS operations and maintenance costs is a critical component when developing an implementation project. Operation and maintenance of ITS technologies and systems extends beyond simply keeping the equipment working. The City will need to maintain ITS devices and systems, and will require appropriate training to serve in that role. Reacting to emergency failure conditions, maintaining accurate maintenance logs, and conducting preventative maintenance programs all require fully-trained staff. Maintenance of ITS devices will require an allocation of funds within the City budget. A maintenance management system can also be used to track failures and decrease the time needed to repair the failures.

A maintenance plan identifies the criteria for replacement and preventative maintenance and the need for ongoing support for ITS devices and systems. The number of devices and systems that need to be maintained throughout the City will increase in the near-term based on the programmed ITS infrastructure projects. These devices and systems need to be appropriately maintained and effectively operated to provide accurate, reliable, and timely information.

The following three maintenance types are included in this section to recommend maintenance activities based on general guidelines for each type of device, rather than required activities, to allow the City to identify areas where maintenance activities could be introduced based on resource availability:

- **Preventative Maintenance** – What to do to prevent failure – This encompasses a set of checks and procedures performed at scheduled intervals including inspection, record keeping, cleaning, and replacement.
- **Responsive Maintenance** – What to do when something fails – This is the initial reply by field maintenance staff to an ITS subsystem or malfunctioning device. Response maintenance includes minor maintenance activities, major maintenance activities, and major rehabilitation/upgrade activities.
- **End-of-Life Replacements and Upgrades** – What to do when something cannot be fixed – This can be required if the device has experienced frequent malfunctions, failures, or has reached end-of-life and it is more cost-effective to replace the technology rather than continue to maintain it.

Roles and responsibilities, maintenance guidelines, and requirements of City staff should be updated to include preventative maintenance, responsive maintenance, and replacement of ITS devices and systems.

Preventative Maintenance

Preventative maintenance is performed to ensure the reliability and longevity of the mechanical and electrical operations of the system and will reduce equipment failures, response maintenance, road user costs, and liability exposure. Preventative maintenance involves repetitive upkeep to allow devices and systems to operate efficiently and effectively to maximize the operating lifespan of ITS devices. Preventative maintenance includes minor and major maintenance needs, making the frequency of maintenance an important consideration.

The preventative maintenance activities and frequency varies by device, device components, and system, which are outlined in Table 7. The City can refer to this table when incorporating new signals, new ITS infrastructure, or new staff. The City should review and revise the preventative maintenance procedures on an annual basis to ensure new issues are being addressed and equipment is being properly maintained.

Responsive Maintenance

ITS devices and systems have specific maintenance requirements per the manufacturer’s maintenance manual of each device. There are three types of maintenance that ITS devices require to fulfill their intended design for operations and lifecycle:

- **Minor Maintenance** – Minor maintenance includes tasks which can be carried out without large scale testing or the use of heavy equipment. It includes visual inspections and checking of many items, elementary testing, cleaning, lubricating, rebooting/resetting, and minor repairs that can be carried out with hand tools or portable instruments.
- **Major Maintenance** – As well as all items normally done under minor maintenance, major maintenance also includes extensive testing, overhauling and replacement of components, which may require a scheduled power outage and the use of bucket trucks or other heavy equipment.
- **Major Rehabilitation** – Major rehabilitation or complete replacement is contemplated for devices that experience frequent or recurring malfunctions or failures.



ITS MASTER PLAN UPDATE

Table 7 – Preventative Maintenance Recommendations

Intersection PM Checklist	Recommended Interval
Interior Cabinet Check	
Clean Cabinet Interior	Annual
Check controller lamp and door switch	
Check filter	
Check door fit and gasket	
Check locks and hinges	
Check/verify for cabinet timing and log sheet	
Check field block terminal connections	
Signal controller battery backup check	
Check conflict monitor indications	Quarterly
Check all detectors	
Exterior Cabinet Field Check	
Check condition of cabinet exterior	Annual
Check all signal indications	
Check all pedestrian indications	
Check pole conditions and hand hole covers	
Check all signal head back plates and visors	Quarterly
Check alignment of signals and pedestrian heads	
Check condition of pull boxes and lids	
Intersection Field Check	
Visual check of all traffic signs at intersection	Monthly
Visual check of intersection luminaries	
Visual check of all traffic loops	Quarterly
Visual check of other traffic system related cabinets	Annual
Typical CCTV Checklist Items	
Visual check of assembly	Annual
CCTV receiver	
Video transmitter	
Fiber distribution unit	
Cabinet equipment	
Pole or exterior condition	
Typical Message Sign Check List Items	
Field intersection	Every six-months
Sign panel	
Pull boxes	
Cabinet exterior	
Cabinet interior	
Re-lamping	

Table 8 identifies a rule-of-thumb frequency of minor and major maintenance and major rehabilitation for a range of ITS devices that the City will be implementing. These guidelines should be reviewed and updated annually to reflect actual needs in Roseville.

Table 8 – ITS Device and Network Communications Maintenance Guidelines

Equipment	Minor Maintenance	Major Maintenance	Major Rehabilitation
Traffic Signal Systems			
Cabinets	26 weeks	2-5 years	10 years
Signal Heads	26 weeks	2-5 years	10 years
Electronics	13 weeks	N/A	N/A
Traffic Signal Controller	26 weeks	2-5 years	10-15 years
Poles	26 weeks	5 years	15 years
Battery Back Up	26 weeks	2-5 years	10 years
CCTV Camera Systems			
PTZ Units	26 weeks	1 years	3 years
Changeable Message Signs			
Sign Case	-	26 weeks	1.5 years
Protective Devices	26 weeks	1 year	2 years
Pixels, Modules and Drivers	-	26 weeks	3 years
Controllers	-	26 weeks	3 years
Vehicle Detection Systems			
Cabinets	-	26 weeks	10 years
Power Supply	26 weeks	5 years	10 years
Emergency Vehicle Preemption (EVP) / Transit Signal Priority (TSP)	26 weeks	2-5 years	10 years
Loop Detection (per approach)	26 weeks	1 year	5 years
Video Detection (per intersection)	26 weeks	1 year	5 years
Travel Time Readers (per location)	26 weeks	1 year	5 years
Pedestrian Detection (per intersection)	26 weeks	1 year	5 years
Grounding	-	2-5 years	10 years
Controllers	-	26 weeks	3 years
Telecommunication Systems			
Fiber Optic Cable Plant	1 year	5 years	25 years
Communication Switches (field)	26 weeks	1 year	3 years
Wireless Radio Spread Spectrum	26 weeks	4 years	10 years
TMC Equipment			
Servers	26 weeks	1 year	3 years
Communication Switches (TMC/Hub)	26 weeks	1 year	3 years
Rack Equipment	-	1 year	2 years
Workstations	26 weeks	2 years	2 years
Workstation Displays	26 weeks	1 year	3 years
Uninterruptable Power Supply	1 year	5 years	10 years

Data source: Recommended Practice for Operations and Management of ITS (ITE Publication); and International Municipal Signal Association (IMSA) Preventative Maintenance of Traffic Signal Equipment Program.

Development or integration of a maintenance tracking system would be beneficial to keep an inventory of maintenance activities that have occurred on each device. The City’s responsive maintenance tracking should consist of the following maintenance activities:

- Failure detection;
- Work order creation;
- Dispatched resources;
- Response activities;
- Diagnosis;
- Interim repairs; and
- Work order close out.

This tracking will allow the City to identify devices that are not reliable or accurate or have had frequent malfunctions. The tracking will also allow the City to identify appropriate cases for technology replacements where maintenance of an existing technology may be costlier than upgrading to a newer technology. Developing periodic reports and then reviewing those reports are critical to being able to identify frequently failing devices for replacement.

End-of-Life Replacements and Upgrades

End-of-life replacement strategies and upgrades are an important aspect of technology projects because equipment and infrastructure needs to be maintained and/or replaced in a routine manner. Equipment replacement is required if a device has exceeded its life expectancy, either through a sunsetting of manufacturer servicing or a failure in legacy equipment. Equipment upgrades are required when additional functionality is needed that cannot be provided by legacy equipment. This section provides information about what the City of Roseville’s replacement needs are, recommended equipment lifecycle timeframes, and mechanisms available for procurement and maintenance.

Agency Replacement Needs

The City of Roseville should establish an inventory of modernized, supplemental traffic and ITS equipment for replacement of devices in the field as they reach end-of-life or become broken. A typical method for establishing an inventory is to keep 10% of existing field devices for each type. A proper inventory of devices and spare parts that can be accessed to conduct routine and emergency maintenance also needs to be built into the City’s budget cycle. As an example, for every 100 cameras deployed across the transportation network, the City should have at a minimum ten (10) cameras in inventory to be able to be responsive and make repairs/replacements when needed.

Lifecycle Replacement

To adequately prepare for necessary infrastructure updates in the future, the City should consider the estimated lifespan of its infrastructure. Lifecycle replacement mechanisms will need to be developed to stay up-to-date on equipment replacement needs and emerging technology availability. Table 9 should be used as a reference tool for the City of Roseville so that equipment remains current and performs at an optimal level.

Agency Replacement Strategy

A significant portion of the City’s existing traffic signal controllers were deployed over 10 years ago and are nearing their end of life based on anticipated lifecycle timeframes. Therefore, the City should initiate a replacement strategy for traffic signal controllers.

It is recommended that the City also consider conducting a traffic signal control systems evaluation prior to procurement of replacement controllers to determine a future path for the central system. As part of this effort, functional requirements and system specifications would be developed to establish standards for the future system.

Table 9 – Anticipated Technology Lifecycle Timeframes

Equipment	Anticipated Lifecycle Timeframe (Years)
Traffic Signal Systems	
Cabinets	20
Signal Heads	20
Electronics	10
Traffic Signal Controller	15
Poles	50
Signal Battery Back Up	10
CCTV Camera Systems	
PTZ Units	10
Changeable Message Signs	
Sign Case	10
Protective Devices	10
Pixels, Modules and Drivers	6
Controllers	6
Vehicle Detection Systems	
Cabinets	20
Power Supply	20
Emergency Vehicle Preemption (EVP) / Transit Signal Priority (TSP)	10-15
Loop Detection (per approach)	5-15
Video Detection (per intersection)	10
Pedestrian Detection (per intersection)	10
Grounding	25
Controllers	7
Telecommunication Systems	
Fiber Optic Cable Plant	25
Communication Switches (field)	5-8
Wireless Radio Spread Spectrum	20
TMC Equipment	
Servers	5
Communication Switches (TMC/Hub)	5-8
Rack Equipment	5
Workstations	5
Workstation Displays	5
Uninterruptable Power Supply	20



Considering the date of installation of other existing ITS equipment, and the expected lifespan of each device according to **Table 9**, the City should consider following a replacement strategy based on the anticipated lifecycle described above to proactively procure and install/replace legacy equipment. Actual replacement rates will depend on environmental conditions (i.e., extreme temperatures, dust), actual failures, staff capacity, and funding availability. The following replacement quantities should be a starting point and are based on the end-of-life ITS equipment devices currently operating in Roseville. Once more ITS devices are installed and connected to the network these rates should be increased proportionally.



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VII FUNDING OPPORTUNITIES

Implementation of many of the projects identified by this Plan are contingent upon acquiring additional funding. The following are potential funding opportunities for ITS infrastructure and systems that are described in additional detail below:

- Local Funding Programs
- State Funding Programs
- Federal Funding Programs
- Grants/Pilot Programs
- Other Funding Types

The City of Roseville has been successful at identifying and obtaining numerous grants to assist with the deployment of their existing ITS. Many of these same funding opportunities are still available, and the City should continue to apply for funding from these sources.

A. Local Funding Programs

The City of Roseville has a Capital Improvement Program (CIP) established on an annual basis. Each CIP outlines suggested transportation improvement and a corresponding budget. The 2020-2024 CIP includes signal and striping modifications, streetlight/pole improvements, traffic safety improvements, traffic signal upgrades, etc. While not all projects outlined in the CIP are related to ITS improvements, the CIP indicates budget available for transportation-specific projects.

B. State Funding Programs

The State Highway Account is essentially a bank account that funds a variety of California programs for transportation and traveler mobility purposes. The SHA receives its funds from the State Base Excise Tax and the Federal Highway Trust Fund. The programs that are directly applicable to local/regional ITS projects are described in Table 10.

Other state funding opportunities include the following:

Highway Safety Improvement Program (HSIP): HSIP funds are administered by Caltrans. Caltrans-initiated safety projects are eligible for HSIP funding if they are participating with a local agency. These projects typically included updated traffic signals or other projects that lend themselves to cost sharing between agencies. The application for HSIP funding must come from the local agency who is partnering with Caltrans on a safety project.

Senate Bill 1 (SB-1): SB-1 is the Road Repair and Accountability Act of 2017, which confirmed a legislative packaged that invests \$54 billion over the next decade to fix roads, freeways, and bridges across California, while also addressing safety, congestion, accessibility, economic developed, air-quality and land use issues. Caltrans will receive roughly half of the allotted SB-1 funds, receiving \$26 billion for state-maintained transportation projects. The California Transportation Commission administered the funds and evaluates funding allocation.



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Table 10 – State Transportation Funding Opportunities

Program	Important Dates	Funding Information	Criteria
State Regional/ Interregional	<ul style="list-style-type: none"> • Multi-year CIP. • Cycle begins in odd-numbered years with the release of fund estimate in July. • December 15th of odd-numbered years the ITIP/RTIP/STIP is submitted 	<ul style="list-style-type: none"> • Local agencies work with their MPO to get their projects included in the RTIP for nomination 	<ul style="list-style-type: none"> • Must include a Project Study Report (PSR) or an equivalent for non-State Highway projects • Caltrans/Regional consultations for projects are to be included in the STIP/RTIP/ITIP • Evaluated on how the project aligns with furthering regional objectives, particularly for Sustainable Communities Strategies • STIP Guidelines
California Transportation Commission Active Transportation Program (CTC ATP)	<ul style="list-style-type: none"> • Distributed annually 	<ul style="list-style-type: none"> • 40% of funds go to MPO's in urban areas • 10% of funds go to small urban or rural communities and awarded by the Commission on a competitive basis • The remaining 50% is competitively distributed on a statewide basis 	<ul style="list-style-type: none"> • Selected through a competitive process and meet one or more ATP program goals. • Minimum funding request is \$250,000 • ATP Guidelines

C. Federal Grant/Pilot Funding Programs

Many federal programs distribute money directly to the State, which then distributes the funds based on local policies or award programs. One example of this type of funding is described above in the State Highway Account which receives a portion of its funding from federal programs. Other programs are described below.

Surface Transportation Block Grant Program (STBG): The STBG is an approved funding program through at least 2020. Infrastructure-based ITS capital improvements, including the installation of vehicle-to-infrastructure communication equipment, are eligible for the grant. In addition, operational improvements (including capital and operations costs) for traffic operations facilities, environmental measures, and some parking strategies are eligible. The project must be identified in a Statewide Transportation Improvement Program (STIP) and be aligned by long range Metropolitan Transportation Plans. Federal share is generally 80% although there are stipulations that allow for a full 100% share or as low as 50% federal share and is determined by project type per 23 U.S.C. 120.



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Transportation Infrastructure Finance and Innovation Act (TIFIA): TIFIA is not a grant or traditional funding program but is a credit assistance program awarded to qualified projects of regional or national significance. TIFIA credit assistance is available to federal ITS projects of at least \$15 million and the credit assistance is limited to 33% of the total eligible project costs.

Better Utilizing Investments to Leverage Development (BUILD) Grants: The BUILD program has replaced the Transportation Investment Generating Economic Recovery (TIGER) grant program and grants are awarded on a competitive basis for projects with significant regional or local impacts. These grants are designed to benefit surface transportation systems while providing further support to rural communities. A greater share of BUILD grants will be awarded to projects located in rural areas. \$1.5 billion dollars has been made available for BUILD grants through September 2020. BUILD funds may cover up to 80% of project costs in urban areas and 100% of project costs in rural areas. During the 2018 cycle, the maximum project award is \$25 million, and a single state cannot receive more than \$150 million. The application deadline for BUILD grants is late July of each year.

The Nationally Significant Freight and Highway Projects (INFRA) Program: The INFRA Grants program provides dedicated, discretionary funding for projects that address critical issues facing our nation's highways and bridges. In 2018 approximately \$1.5 billion in INFRA Grants will be awarded to projects across the country.

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD): ATCMTD is a competitive grant program that funds projects related to many ITS objectives. The grant serves to fund installation of transportation technologies that can improve efficiency, safety, and system performance. A state, local, transit, or Municipal Planning Area (MPA) agency is eligible to apply. In addition, a multijurisdictional group can apply with a signed agreement. A maximum of \$60 million is available each fiscal year through 2020. A 50% minimum local match is required. Single project awards will not exceed \$12 million and there will be between 5 and 10 grants awarded. Applications are invited during the Spring of each year.

D. Other Funding Types

Other funding opportunities that the City could utilize to help support their ITS Program include:

Safety/Emergency Projects/Initiatives: Partnering with other departments or emergency/safety agencies to include ITS components or to identify additional data that can be obtained from emergency/safety service systems could be mechanisms used to expand the ITS program or data that is available. An example might be a project to upgrade the radio network of the Police Department.

Establishing Open Funding Streams: Some states and MPOs have developed alternative methods for financing congestion reduction efforts, including ITS projects. Supplemental traditional funding sources could include tolling; local/regional sales tax measures, or other fees; and develop partnerships with private industry.

Public/Private Partnerships (P3s): P3s can provide alternative funding sources for transportation projects when a public agency enters into a partnership/agreement with a third party private company. Essentially, the public agency brings in a private-sector firm who provides development, operation, and financing mechanisms for the transportation project. P3s have become more popular as public resources become more limited and the demand for improved transportation systems continues to increase. There are benefits and limitations to engaging in a public/private partnership, so it is important to weigh those factors prior to P3 implementation.



VIII SUMMARY & RECOMMENDATIONS

The City’s initial 2005 Intelligent Transportation System (ITS) Master Plan set the stage by establishing a migration path for technology to become more prominent and integrated with the agency’s forward thinking traffic management program. Since then, a significant portion of that Plan has been implemented; major technological advances have occurred, especially in the areas of camera technology, detection, and performance monitoring techniques; a tax sharing arrangement was forged with Placer County from which a significant growth area west of the City was identified for annexation; and the City recognized a need to assess the life-cycle and replacement strategies for existing and future equipment. The Plan was updated in 2012 and is now being updated once again to reflect these recent changes and re-calibrate the City’s path towards achieving its goals and objectives with an eye toward the next 10 years of technology deployment and infrastructure buildout. The City’s vision for this Master Plan Update is “To provide a safe, efficient, and reliable customer centered transportation network through the use of technology, timely maintenance, and public communication.”

A total of 36 ITS technology solutions have been identified for consideration in this updated ITS Master Plan. Completion of the build-out of the City’s ITS and communications infrastructure will result in numerous redundant communication rings and expansion of CMS coverage; and the City’s ITS communication infrastructure will be well positioned to accommodate the planned growth and future expansion envisioned over the coming decade. The ultimate communication deployment includes further expansion to the west, and closure of “internal” gaps to complete the overall redundant communication ring. Additional Wifi unit installations are recommended to provide the City with an efficient process to obtaining traffic data to aid the City in determining existing and future travel patterns and traffic demands. Additional CMS are also recommended to provide the City with the ability to more proactively notify motorists of abnormal conditions at locations where alternate travel patterns can be achieved.



The City should continue to pursue multiple funding sources for the deployment of the recommended system expansion and enhancement. Both Federal and State funding sources should be monitored and pursued when grant opportunities are released.

As a result of the rapidly evolving ITS technologies and their applications to traffic operations and communications, it is recommended that the City continually monitor the recommendations and deployment strategy included in this ITS Master Plan. At a minimum, similar to the timing of this update, the City should consider a thorough re-assessment of their vision, strategies, and application of technologies every five years. Furthermore, on an annual basis, the City should closely track the implementation of individual projects to more comprehensively evaluate the overall Plan implementation and continuity with new developments and the influence of adjacent jurisdiction actions.



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A Appendices